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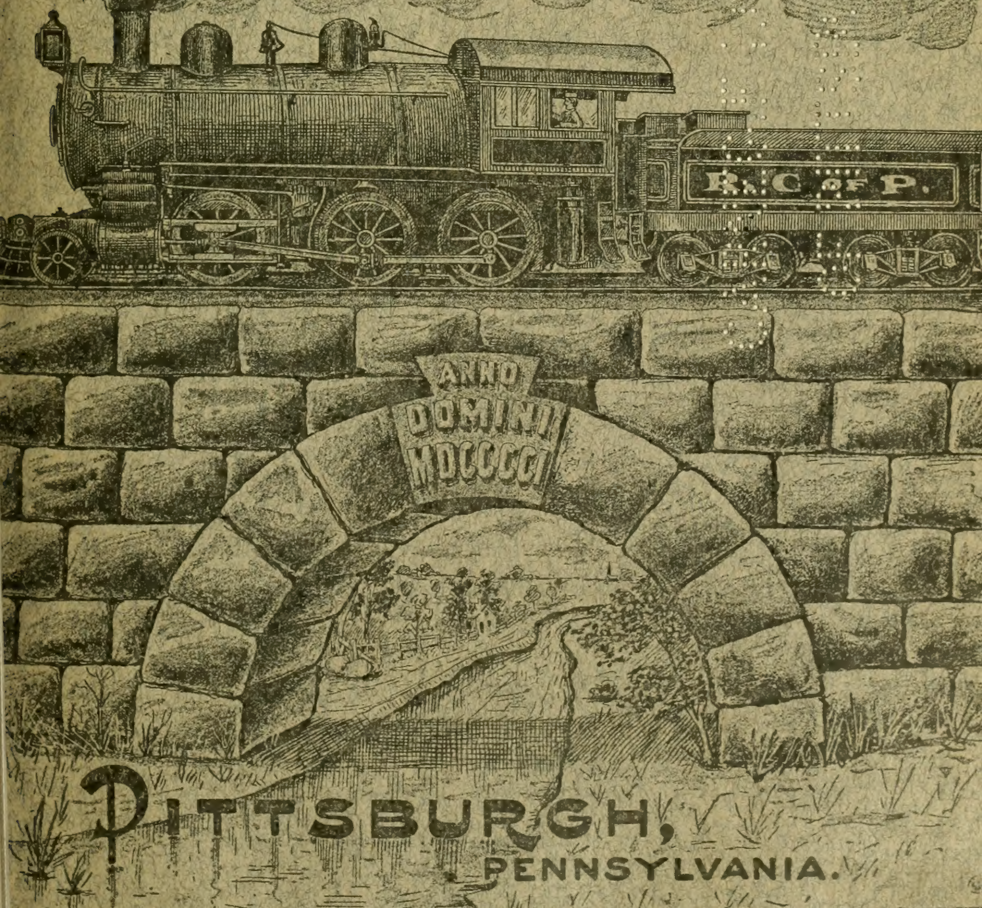

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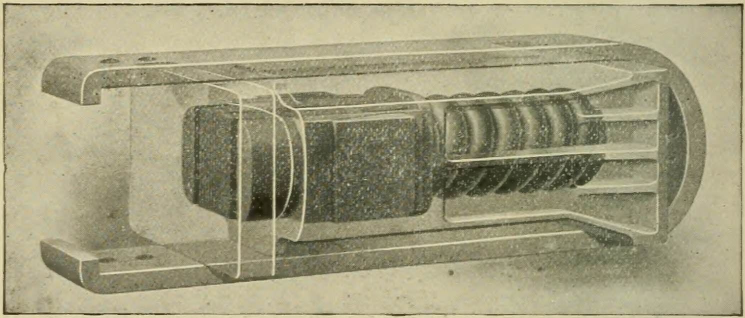

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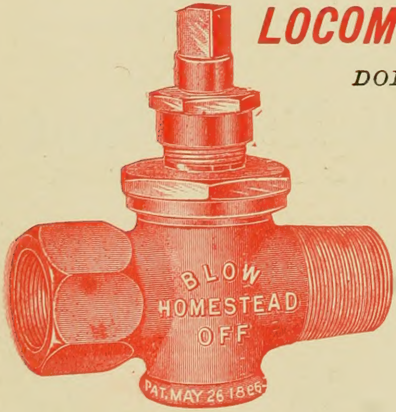

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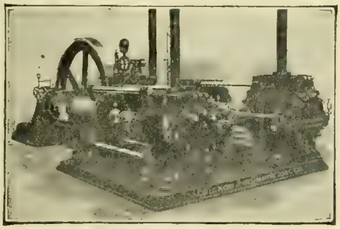

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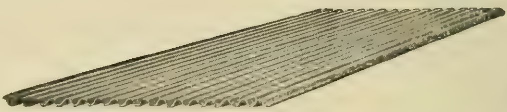

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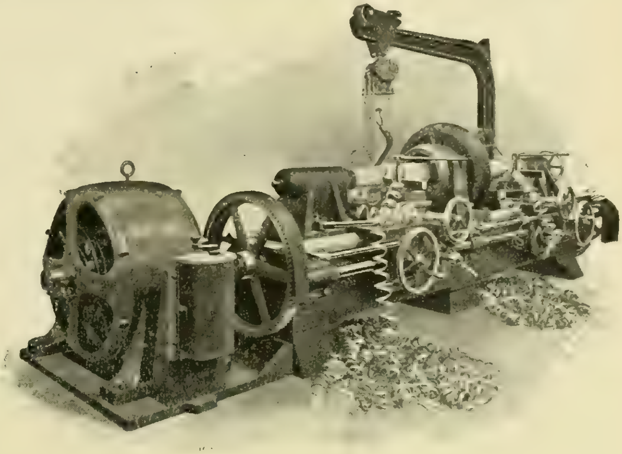

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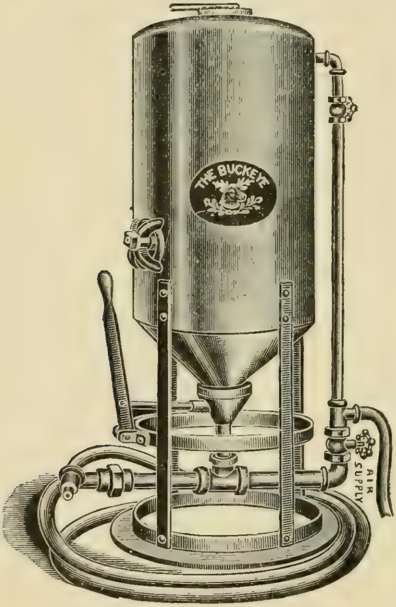

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VOL. VII.
No. 1.

**Pittsburgh, Pa., Nov. 22, 1907.**

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Published monthly, except June, July and August, by the Railway Club of Pittsburgh,
J. D. Conway, Secretary, General Offices P. & L. E. R. R., Pittsburgh, Pa.

*Meetings held fourth Friday each month, except June, July and August.*

## PROCEEDINGS OF MEETING,

## NOVEMBER 22nd, 1907.

The meeting was called to order at the Monongahela House, Pittsburgh, Pa., at 8 o'clock, P. M., with President H. W. Watts in the chair.

The following gentlemen registered:

## MEMBERS.

Anderson, H. T.
Alleman, Chas. W.
Allen, H. L.
Allen, James P.
Baker, Jas. H.
Bihler, L. C.
Bole, Robt. A.
Bostwick, W. A.
Brewster, Morris B.
Brown, Geo. P.
Brownscombe, G. J.
Carson, G. E.
Coey, David B.
Conway, J. D.
Coulter, A. T.
Cox, P. L.
Cunningham, J. D.
Edmonds, J. F.
Elder, Thos. W., Jr.
Flynn, J. A.
Foller, Chas. T.
Gibson, J. A.
Gies, Geo. E.
Gulick, H.
Hall, C. W.
Halleran, H. J.
Henderson, J. W.
Herrold, A. E.
Hill, M. H.
Hinsdale, C. L.
Howe, D. M.
Huyett, E. G.
Kessler, D. D.
Kennedy, Jas.
Keyser, R. H.
Turner, L. H.
Kiefer, Ralph F.
Kinter, D. H.
Knight, E. A.
Knox, Wm. J.
Krause, Julius.
Lobez, P. L.
Mason, E. F.
Miller, F. L.
McIlwain, J. D.
McKee, Frank W.
McKee, Ira E.
McNulty, F. M.
Nickerson, S. N.
Oates, Geo. M.
O'Neal, J. E.
Parke, H. B.
Peacock, W. W.
Pearce, Robert W.
Phelps, W. H.
Pollock, Geo. L.
Porter, H. V.
Redding, D. J.
Sanville, W. F.
Schoen, Chas. T.
Schuchman, W. R.
Sellers, C. E.
Shaler, Fred. J.
Shannon, Chas.
Slocum, A. W.
Stewart, W. W.
Stucki, A.
Swann, J. B.
Tate, R. H.
Taylor, H. G.
Trinler, Chas. M.
Watts, H. W.

Warne, J. C.
Warnock, H. R.
Williams, H. G.
Wood, W. H.

## VISITORS.

Beebout, D. W.
Benner, J. W.
Benner, Samuel A.
Benton, W. H.
Borden, R. L.
Bowman, C.
Butts, G. W.
Cain, H.
Carter, W. C.
Chapin, E. S., Jr.
Coble, J. M.
Cramer, Ed.
Crozier, J. T.
Faunce, Benj. F.
Fowler, Geo. L.
Gallinger, Geo. A.
Gray, Chas. B.
Jackson, Chas. T.
Lowry, R. N.
Maxwell, Lee H.
Moore, Herbert.
Murdock, Austin J.
Pollard, E. C.
Powell, H.
Rancell, Geo. H.
Rhodes, P. S.
Shelden, J. N.
Smith, David M.
Smith, G. Preston.
Thompson, W. K.
Trist, N. B.

The minutes of the last meeting being in the hands of the printer, the reading of them was dispensed with.

Secretary Conway read the following applications for membership:

Ackenheil, J. D., Rep. The Patterson-Sargent Co., 8 Jay St., New York City.

Benner, Jacob W., Chief Engr. Stm. Power, Carnegie Steel Co., Homestead Works, Munhall, Pa.

Benner, Saml. A., Genl. Mgr. Sales, Carnegie Steel Co., Carnegie Bldg., Pittsburgh, Pa.

Birney, E. H., Supt. Rolling Mills, Jones & Laughlins Steel Co., 1639 Dennison Ave., Pittsburgh, Pa.

Bowers, K. J., Mgr. of Sales, Acme White Lead & Color Co., Detroit, Mich.

Butts, G. W., Inspector, P. R. R. Co., Altoona, Pa.

Campbell, F. C., Rep., Acme White Lead & Color Co., Detroit, Mich.

Charles, John G., Yard Master, Mon. Con. R. R., 4734 Kansas St., Hazelwood, Pa.

Irwin, E. P., Chief Clerk to Car Foreman, Mon. Con. R. R., 237 Atwood St., Pittsburgh, Pa.

Kerchner, R. M., Union Electric Co., Ter. Warehouse Bldg., Pittsburgh, Pa.

Lockhead, J. S., Asst. Supt., Rolling Mills, Jones & Laughlin Steel Co., 4621 Center Ave., Pittsburgh, Pa.

Mackin, J. J. D., Rep., Edison Portland Cement Co., Machesney Bldg., Pittsburgh, Pa.

Mercur, H. T., Rep., Railway Materials Co., Old Colony Bldg., Chicago, Ill.

Stuart, Malcolm D., Special Agt., Eastern Div. Penna. Lines West of Pgh., care H. K. Brady, Train Master, Allegheny, Pa.

Yearwood, Byrd O., Genl. Insp'r., Seaboard Air Line Ry., Portsmouth, Va.

Young, W. W., Pur. Agt., The Union Switch & Signal Co., Swissvale, Pa.

PRESIDENT: As soon as these applications have been favorably passed upon by the Executive Committee the gentlemen will become members.

If there is no further business, we will proceed to the paper of the evening, by Mr. Geo. L. Fowler, on the "Car Wheel."

MR. GEORGE L. FOWLER: Mr. President and Gentlemen:—It seems rather presumptuous for a New Yorker to come to Pittsburgh and attempt to state anything that will be at all novel in regard to the manufacture or the products of iron and steel. I should not have presumed to appear before the Club this evening had it not been that I was fortunate enough to be engaged in investigating wheels for the last two or three years, under the auspices of the Shoen Steel Wheel Company, and have some data which may be new and I trust more or less interesting.

In the first place, I want to pay a tribute to the cast iron wheel. Some one has said that the flange of the car wheel was the most important invention of the nineteenth century. I think it could be added very well, that the cast iron wheel has done more for the development of the American railroads than any other one item in railroad use. Without it it would have been quite impossible to have had the rapid railroad development which we have had. The railroads in the West were built out on the prairie over a territory where there was no prospect of any immediate traffic, and the equipping of these roads would have been quite impossible, owing to the necessity of keeping the cost down to the lowest possible notch, had it not been for the cast iron car wheel. The cheapness of the cast iron wheel has been the saving of the roads of America and one reason for their rapid development in sparcely settled territory.

We hear a great deal today in regard to the deterioration in the quality of the cast iron wheel. I don't know anything at all in regard to that, and I doubt very much whether very many people do. We must consider that when the cast iron wheel was developed and up to 25 years ago it had comparatively little work to do. Now we are loading to four, and four and a half times the weights it was required to carry before—and because it fails we think it is of inferior quality! We have seen car capacities rise from ten tons to thirty, and yet cause very little trouble because of the cast iron wheel. At 80,000 pounds there was still apparently very little more trouble than there was at 60,000. But when it came to putting those wheels under cars of 100,000 pounds capacity it seemed as though the last straw had been put upon the camel's back and it was broken. It is an open secret that the cast iron wheel under cars of high capacity is giving not only a great deal of trouble, but causing a great deal of anxiety to the railroad world.

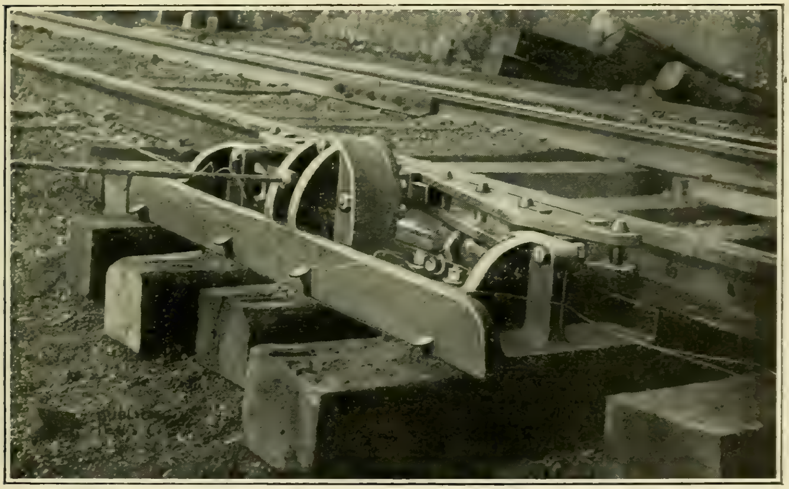
I have here on the screen a slide showing the old M. C. B. standard tread and the change which was made in the tread and flange, showing the reinforced flange that has recently been adopted as recommended practice by the Master Car Builders' Association. You will see that the flange has been strengthened and there has been a slight change made in the taper of the tread. That is all that can be done with the cast iron wheel, as it stands, so far as the strength of the flange is concerned. There have been a number of improvements tried, as to the location of the web and plates, but they have not been worked out far enough as yet to show what they are really worth.

The question resolves itself then into the two main problems, how strong is the cast iron car wheel, and what are you asking it to do? About two years ago Prof. Goss, of Purdue University, made a series of investigations in regard to the strength of the flange of the cast iron wheel. He put it under his testing machine in such shape that a plunger coming down on the flange acted on it in exactly the same way that the rail goes against the flange of the wheel, and pushed it off. In determining how much pressure it would take to push it off, he found that it varied very considerably. With M. C. B. flanges the breakage ran from 47,500 to 87,000 pounds. With the reinforced flange the breakage was at from 82,000 to 105,900. That was the total pressure that had to be exerted against the flange of the wheel to break it off. While these differences are very great, they actually cover conditions existing in a single wheel. For example, those last strengths of 82,000 and 105,900 were from one and the same wheel, of the reinforced type, while on others of the standard contour it ran from 68,000 to nearly 100,000 pounds.

Now it is very well known that brake shoes on a long grade do not improve the strength of the cast iron wheel. It is weakened and cracks are frequently formed on the inside which cannot be detected by outside examination; and a great many wheels are broken in detail where the crack starts in the interior of the metal, working its way out gradually, and when it does let go the flange breaks suddenly and gives way, showing that only a part of the metal had been holding. It would not be an exaggerated statement to say that car wheels by such action are weakened at least 10%, especially if you will give them the benefit of the wear to which they are subjected before they reach the limiting point of the M. C. B. flange gauge.

On the other hand, a steel wheel subjected to the same test and with the flange pushed off in identically the same way, broke under a load of 526,612 lbs., which is the ratio of something more than 7 to 1 as compared with the average cast iron wheel, and it is interesting to note that that ratio of 7 to 1 does not vary very much from the ratio of the tensile strengths of the two materials. The cast iron in car wheel work varies in tensile strength from 17,000 to 28,000 lbs. per square inch. I have had a few test specimens of cast iron that broke at 28,000, and a short time ago I ground out a tensile test specimen from a very fine sample of a chilled cast iron wheel and to my surprise it broke at about 36,000 lbs., showing that the chilled iron is quite as strong, if not stronger, in some cases, than the gray iron itself.

Hence, as to the strength, we know pretty well from laboratory tests what we can expect the flange of a cast iron wheel to carry. The question then is, what are you putting on it? One of the principal things that led to the investigation I have been engaged in, was to determine what stresses were actually applied to a car wheel when it is in motion running around a curve. Through the courtesy of the Pennsylvania Lines West a piece of track down near Burgettstown, on the Hickory branch, was placed at my disposal last summer, and I designed an instrument, shown in the illustration, by which the lateral thrust of the wheel on the curve when the train was in motion could be measured. It consists of a piece of rail of the same size that is in the track, floated on rollers and held down by rollers, so that it is perfectly free to move out under the pressure of the flange. On the inside there are some set screws which come up against the base plate to which the rail is bolted, limiting its motion. Under ordinary conditions they limit that motion to a little less than 1-16 inch. As an actual fact, the motion is imperceptible. There are two levers on either end of the rail so fulcrumed that they



act exactly in the same way as a set of ordinary platform scales, dividing the stress by five and carrying it back to the 6-inch cylinder which you see in the illustration. As the wheel passes over the rail it presses against it and the whole of that pressure is carried by fulcrums and by that diaphragm and that is so communicated to a liquid in the interior and carried through the pipe you see extending out beyond the track to the recording gauges which stand six or seven feet away. In that way, as the wheels pass each one records the pressure which it is exerting on the rail. By putting trips on the track which were struck by the oil boxes of the car as the car went by, I obtained the speed of the car, so that with a given speed and the pressure I obtained a set of diagrams which showed what work was actually being done by the car wheel as it passed. The curve was one of a 4° 25′, and the car was one of the Pennsylvania gondolas and weighed 142,300 lbs. when loaded with coal.

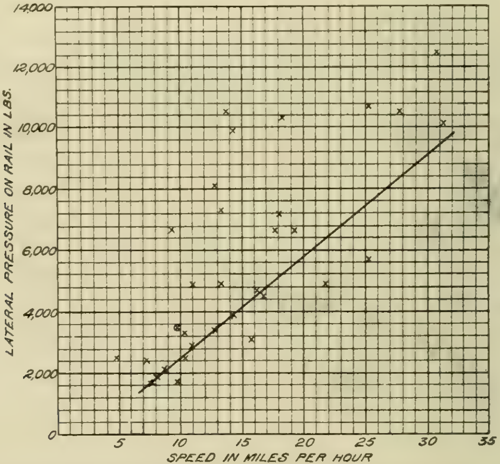


DIAGRAM OF LATERAL THRUST OF LEADING WHEEL OF FORWARD TRUCK OF LOADED COAL CAR TOTAL WEIGHT 142,300 LBS., ON 4° 25′ CURVE.

The method of operation was to take it back up the curve and kick it off as fast as we could with a heavy consolidated engine. We were unable to get any speeds higher than 31.25 miles an hour. But up to those speeds I succeeded in getting a registration of the pressure of every wheel as it passed. The results are shown on the diagram. You will notice that from about seven miles an hour up to sixteen there is a line of crosses that are very nearly in a straight line. I may add that the elevation of the curve was 3-⅞ in., which corresponds to a speed of 36⅔ miles an hour; so that, at no time was the speed of the car in excess of that provided for by the elevation of the outer rail. From that data shown on the diagram I have drawn a straight line which is offered purely as a tentative formula for the thrust of the front wheel of the forward truck. I am free to admit that the data is not sufficient to warrant an assumption of anything positive in regard to the influence of speed on the pressure of the wheel against the rail. I assume it to be a straight line because of the location of the crosses and because where the outer rail is elevated above that required to balance the centrifugal force due to the speed, the rail has nothing to do but to deflect the car from its natural tangential course, and the more rapidly the car moves and the shorter the space of time that that pressure is exerted the higher will it be, and it will be in an inverse ration to that length of time. Therefore, if a car is moving over a curve at 30 miles an hour the pressure will be exerted for only half the length of time it will be if running 15 miles an hour, and will therefore be just twice as great.

The equation for the straight line shown is

$$333D - 800,$$

which is, of course, an absurdity for lower speeds, but it is an equation for that line. You see away above the line there are a great many high pressures, showing heavy blows.

By carefully watching the car during the whole of the time I found that there was a difference in the way it was riding on the side bearings, and from other experiments made elsewhere I have learned that the condition of the side bearings, and the way the car rides on them, has a very great deal to do with the ease of curving of the car or truck. So that if the car is down hard on the side bearings it naturally follows the curve with greater difficulty and there is apt to be a greater thrust on the rail at the same time than where it is free and clear. A train of empty coal cars, for example, in which I got a registration for every wheel on the train, showed the widest variation between wheels of two successive cars. And moving at 10 to 12 miles an hour over the instrument as they did, it was impossible to detect from the eye exactly what caused that or what the differences in the condition of the cars were. But one could see enough to know that they varied very widely in the way in which their bodies were down on the side bearings and in the way in which the truck was standing on the curve itself.

We will also find that the blows received on a curve will be due to soft spots in the track, kinks in the curve, low joints, as well as cramped side bearings. But when a speed greater than that corresponding to the elevation of the rail is obtained, then, of course, centrifugal force will come in. In this case at 40 miles an hour the centrifugal force would be greater than at 36. As for the intensity of the blows, one at 13⅔ miles an hour reached a maximum of 10,460 lbs., or 6,709 lbs. above that called for by the formula. Now if we would add this to what is called for by the formula at 45 miles an hour it will give a pressure on the wheel of 19,229 lbs., and if it were to be proportioned to the speed it would rise to over 36,000 lbs. Therefore, when you take into consideration that this work was done on a comparatively easy curve of only 4° 25′, and that 8° curves are common all over the country, what happens if you run over that at the rate of 35 or 40 miles an hour? It does not seem to be an exaggeration at all to say that the flange of a car wheel ought to be able to carry a load of at least 30,000 lbs., and do it safely. If we take that as a basis and then take the average of the cast iron wheel strength with the ordinary M. C. B. standard flange, that strength runs to about 80,000, and it gives us a factor of safety of a little over 2½. But, on the other hand, if we take the weakest flange that we found in a new wheel it cuts our factor of safety down to a little more than 1½. And if you deduct 10 per cent. from that for your wear and brake shoe action your factor of safety drops down to 1.4 per cent.

Now the question comes up as to what it is safe to do. There is a photograph of a cast iron flange breaking in detail, showing an incipient fracture existing there before the flange let go. And such accidents as that, with that as a typical break, is apt to produce some such results as we see on this slide, which is a case occurring not far from here where a broken wheel had actually caused the wreck of a bridge. That was certainly an expensive car wheel.

There is another case of the flange being responsible for both these things, a wrecked engine and the car in the ditch.

These features and results must not be considered, however, as at all derogatory to the cast iron wheel. It is merely a case of overloading. When we had ten ton capacity cars we were putting about a fourth the amount of load on the wheel that we are putting on it now, and if, as I think, the pressure on the rail varies as the weight, then the thrust was only a fourth of what it is now. So that, instead of 30,000 lbs. which ought to be provided for, we had only 7500 lbs., and that was so far within the margin of safety there was no necessity of even investigating these stresses. The idea of putting a steel wheel under a car of 10 tons capacity was so absurd that you would all have laughed at it. But when you increase the load and the stresses fourfold the question assumes an entirely different aspect, and the problem of the adoption of the steel wheel under high capacity cars is something that is pressing close upon the railroads now and they are considering it very seriously, while some are adopting it.

The case of the cast iron wheel is very similar to that which we had here a few years ago in the Kinzua viaduct on the Bradford division of the Erie Railroad. In 1887 the Erie built the largest and strongest and best viaduct there was in the world over the Kinzua valley. It was capable of carrying the heaviest engines and cars. It was a model of engineering work. In 1902 it was just about as good as the day it was put up. It had been carefully inspected and maintained and was safe and sound. But it was torn down to the foundation simply for the reason that it was not strong enough to carry the modern traffic. So the cast iron wheel, good as it is under 10 ton cars, does not seem quite good enough to put under a car of 100,000 lbs. capacity. Whether you will agree with that statement or not depends altogether on the risk that is considered safe for a railroad to run, and whether it is a proper thing to run with such a low factor of safety as a possible 1½.

In addition to the work which I have just outlined, the question arose as to the development and manufacture of a steel wheel which should be suitable for high capacity cars. The problem, as presented, is that of making a wheel the material of which should be equal in every respect to that of a first class steel-tired wheel, which is rendering satisfactory service under passenger equipment, and at the same time be of such moderate cost as to place it within the reach of the railroads so they can afford to use it on their high capacity freight equipment. The solid steel wheel was developed with that end in view, and in order to determine whether the metal in the wheel and its capacity to do work were up to the high standard which had been set by the railroads in the steel-tired wheels they were using, a series of investigations were instituted to make a comparison between the metal in this wheel and that in the various steel and steel-tired wheels which were already upon the market and which were giving satisfactory service. These tests included tensile tests, showing the tensile strength, elasticity, elongation, reduction of area and hardness, resistance to abrasion and specific gravity, the chemical composition of the several wheels together with a microscopic examination of the texture of the metal. Then tensile strength test pieces were cut from points in the tread of all the wheels and tires which were obtained, and these were bought in the open market and as such were taken as representative of their class. And the results that were obtained have been such that any manufacturer could be proud of what has been shown. The tensile test pieces were limited to a length of 2 inches because the curvature of the tires and of the wheels would not allow of the cutting out of anything longer than that.

In the tensile tests the breaking load ran from about 113,000 to 124,000 lbs. The test of 113,000 was from what is indicated as the D tire. I had four tires which were indicated as A, B, C and D. The D tire was the softest of the lot. As you will see later, the carbon content was the lowest, running about .57, increasing through those several tires and wheels to about .716, which was that of the A tire. The solid steel wheel or the rolled steel wheel had the chemical carbon content of .69, so that the two were comparatively close together. The chemical analysis was very carefully made by an experienced chemist, and made with combustion tests, so that it is reliable and checks very closely with the carbon content at which the manufacturers themselves place it. The strength of the solid wheel is a little bit higher than any of the others except the A tire. The A tire had a maximum strength of 124,000 and a few hundreds, and the solid steel wheel dropped down about 400 or 500 lbs. less than that, so that they were practically the same. As would naturally be expected from such tests as that and from the chemical content, the elongation was very much less with the rolled steel wheel than with some of the others, more especially the D wheel, which was the lowest in carbon content.

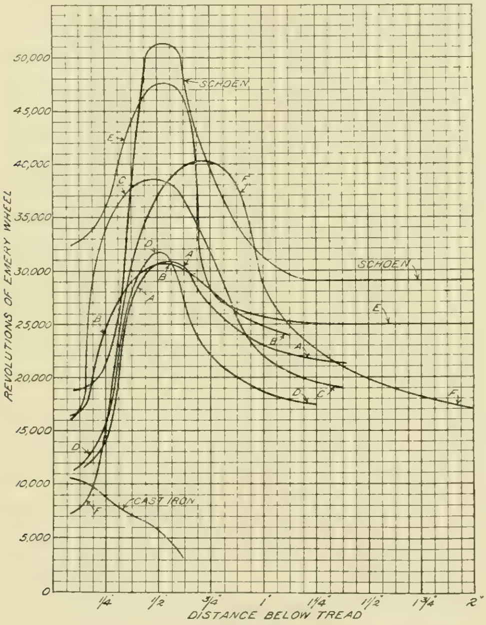
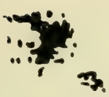


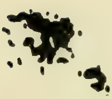
DIAGRAM OF ABRASION TESTS OF STEEL TIRES AND WHEELS, SHOWING RELATION OF RATIO OF WEAR AT VARIOUS DEPTHS BELOW TREAD TO REVOLUTIONS OF EMERY WHEEL.

At the same time the influence of work was very remarkably shown. The test was made for hardness with all the tires with what is known as the Martel drop. During our Civil War Col. Rodman developed a system of measuring hardness in his guns by pushing a punch of a crtain shaps into soft metal and measuring the amount of power required to reproduce the same impression. That was developed by Lieut. Col. Martel, of the French army, and has been adopted by the French government as the standard of hardness. It consists of dropping this punch on the material to be tested with any weight and from any height, and the formula that has been developed is that the hardness is equal to the weight multiplied by the height and divided by the volume of the material displaced. On that basis the rolled steel wheel was the hardest of any of the metals, being 25 per cent. harder than any of the tires that were placed in competition with it. This shows itself in another way, as I shall show later on by some abrasion tests which are shown on the diagram. The weight I used was allowed to drop 600 millimeters, and it weighed 2.2616 kilograms. Those weights were very carefully made on a torsion scale so I have every reason to think they are very accurate.

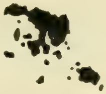
The diagram shows the results of some abrasion tests. Cylinders ½ in. in diameter were cut from the tread of the wheel extending directly down into it as though they were bored out by a hollow bit. The same thing was done with the cast iron wheel. I used a fine grained carborundum wheel running about 2500 revolutions a minute and placed the cylinder with the tread end down and loaded it with 2 lbs. 11½ oz., kept it perfectly cool with water during the running, and measured the number of revolutions required to grind it down ⅛ in. I found that in going down into the tread for the first ⅛ in. the number of revolutions required kept increasing, and they increased down to about ½ in. and then began to decrease. Under ordinary conditions I would have supposed that was due to the fact that the wheel was glazing over and was not cutting as rapidly. But I had those A, B, C and D tires well under way before the cylinders for the other wheels were ready, and when they were finished they did the same thing exactly, so that it does not seem possible that there was any glazing of the wheel, and none could be detected. During the whole of the work it only wore the wheel down about 3-64 in. The cast iron wheel cut away more rapidly than any of the steel wheels. This line in the lower left hand corner that starts at 10,500 and drops down at once was from a first-class cast iron wheel; its chill was about ⅝ in. deep, very hard and perfectly clean and clear cut. It was a beautiful piece of chilled metal. Of course, it would be expected that the falling off would occur when the chill had been worn through, but really the immediate drop at the tread came as a surprise. I did not expect it to fall so far below any of the steel wheels and tires that it was in competition with.



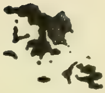
500 Lbs.
Av. Pressure per
Sq. In. 9,090 Lbs.
Area .055 Sq In.



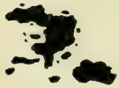
1,000 Lbs.
Av. Pressure per
Sq. In. 14,285 Lbs.
Area .07 Sq. In.



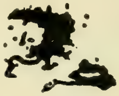
2,500 Lbs.
Av. Pressure per
Sq. In. 33,333 Lbs.
Area .075 Sq. In.



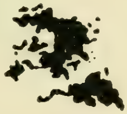
3,500 Lbs.
Av. Pressure per
Sq. In. 43,750 Lbs.
Area .08 Sq. In.



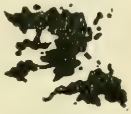
4,500 Lbs.
Av. Pressure per
Sq. In. 50,000 Lbs.
Area .09 Sq. In.



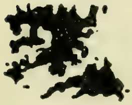
6,000 Lbs.
Av. Pressure per
Sq. In. 54,545 Lbs.
Area .11 Sq. In.



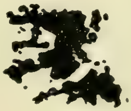
10,000 Lbs.
Av. Pressure per
Sq. In. 83,333 Lbs.
Area .12 Sq. In.



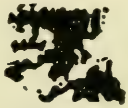
11,500 Lbs.
Av. Pressure per
Sq. In. 88,461 Lbs.
Area .13 Sq. In.



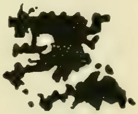
13,500 Lbs.
Av. Pressure per
Sq. In. 96,428 Lbs.
Area .14 Sq. In.



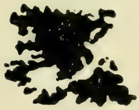
14,500 Lbs.
Av. Pressure per
Sq. In. 96,666 Lbs
Area .15 Sq. In.



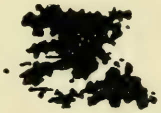
15,000 Lbs.
Av. Pressure per
Sq. In 93,750 Lbs
Area .16 Sq. In.



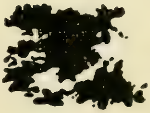
16,500 Lbs.
Av. Pressure per
Sq. In. 97,058 Lbs.
Area .17 Sq. In.



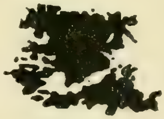
17,500 Lbs.
Av. Pressure per
Sq. In. 94.444 Lbs.
Area .18 Sq. In.



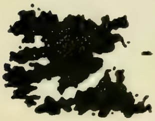
19,000 Lbs.
Av. Pressure per
Sq. In. 100,000 Lbs.
Area .19 Sq. In.



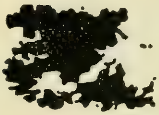
25,000 Lbs.
Av. Pressure per
Sq In 125,000 Lbs
Area .20 Sq. In.



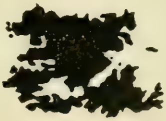
27,000 Lbs.
Av. Pressure per
Sq. In. 128,571 Lbs.
Area .21 Sq. In.



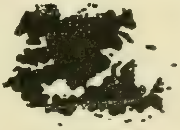
28,000 Lbs.
Av. Pressure per
Sq. In. 127,272 Lbs.
Area .22 Sq In.



30,000 Lbs.
Av. Pressure per
Sq. In. 130,434 Lbs.
Area .23 Sq. In.



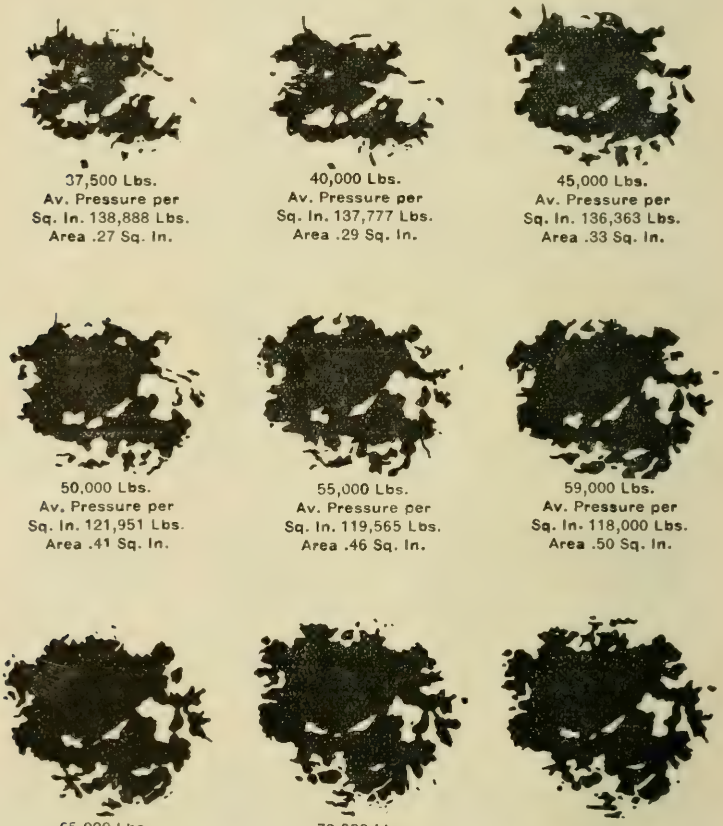
32,500 Lbs.
Av. Pressure per
Sq. In. 130,000 Lbs.
Area .25 Sq. In.



35,000 Lbs.
Av. Pressure per
Sq. In. 134,615 Lbs.
Area .26 Sq. In.

CONTACTS BETWEEN 33 IN CAST IRON WHEEL AND 100-LB. RAIL.

Another matter that was taken up was the effect of load on rail and wheel. Through the courtesy of Mr. Deems, of the New York Central, I had an opportunity of measuring the area of contact between the wheels of his heavy consolidated engines of the Atlantic type and a gondola loaded with coal, a dining car and an ordinary coach. These spots shown are reproductions of the contacts that I obtained in the laboratory in taking a cast iron wheel and loading it successively on a standard rail. I began with 500 lbs., and you will see that the average pressure was about 9040 lbs. to the square inch of area. Coming down



37,500 Lbs.
Av. Pressure per
Sq. In. 138,888 Lbs.
Area .27 Sq. In.

40,000 Lbs.
Av. Pressure per
Sq. In. 137,777 Lbs.
Area .29 Sq. In.

45,000 Lbs.
Av. Pressure per
Sq. In. 136,363 Lbs.
Area .33 Sq. In.

50,000 Lbs.
Av. Pressure per
Sq. In. 121,951 Lbs.
Area .41 Sq. In.

55,000 Lbs.
Av. Pressure per
Sq. In. 119,565 Lbs.
Area .46 Sq. In.

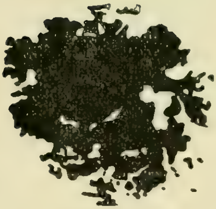
59,000 Lbs.
Av. Pressure per
Sq. In. 118,000 Lbs.
Area .50 Sq. In.

65,000 Lbs.
Av. Pressure per
Sq. In. 118 181 Lbs.
Area .55 Sq. In.

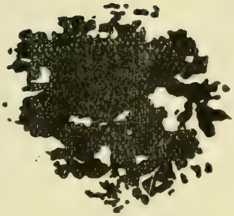
70,000 Lbs.
Av. Pressure per
Sq. In. 118,644 Lbs.
Area .59 Sq. In.

75,000 Lbs.
Av Pressure per
Sq In. 122,950 Lbs.
Area .61 Sq. In.

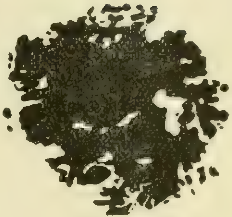
CONTACTS BETWEEN 33 IN. CAST IRON WHEEL AND 100-LB. RAIL.



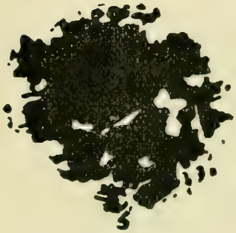
80,000 Lbs.
Av. Pressure per
Sq. In. 126,983 Lbs.
Area .63 Sq. In.



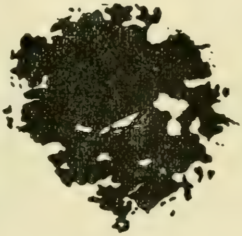
85,000 Lbs.
Av. Pressure per
Sq. In. 116,666 Lbs
Area .72 Sq. In.



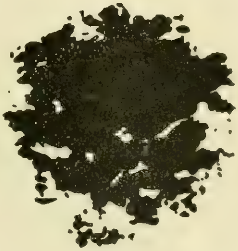
90,000 Lbs.
Av. Pressure per
Sq. In. 121,621 Lbs.
Area .74 Sq. In.



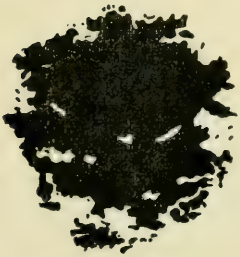
95,000 Lbs.
Av. Pressure per
Sq. In. 121,794 Lbs.
Area 78 Sq. In.



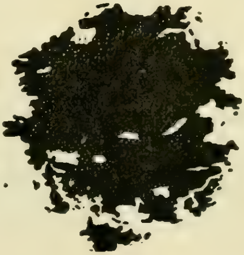
100,000 Lbs.
Av. Pressure per
Sq. In. 120,481 Lbs.
Area .83 Sq. In.



105,000 Lbs.
Av. Pressure per
Sq. In. 117,977 Lbs.
Area .89 Sq In.



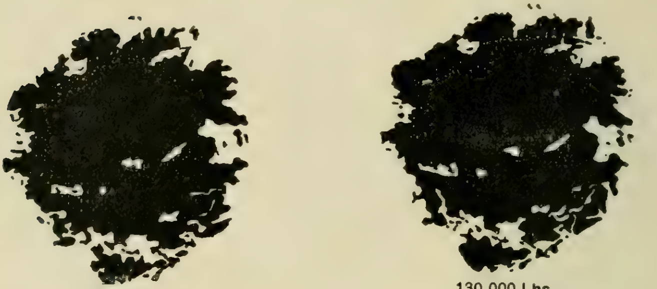
110,000 Lbs.
Av. Pressure per
Sq. In. 118,279 Lbs.
Area .93 Sq. In.



115,000 Lbs.
Av. Pressure per
Sq. In. 116,161 Lbs.
Area .99 Sq. In.

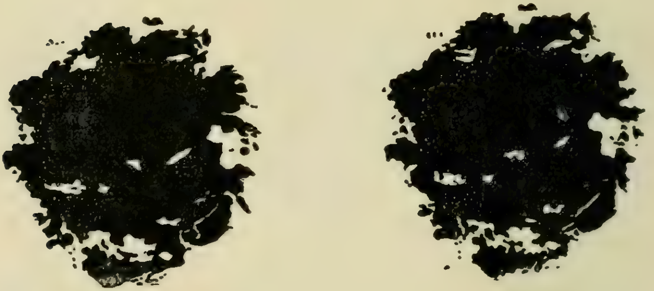
120,000 Lbs.
Av. Pressure per
Sq In. 115,384 Lbs.
Area 1.04 Sq. In.

CONTACTS BETWEEN 33 IN. CAST IRON WHEEL AND 100-LB. RAIL.



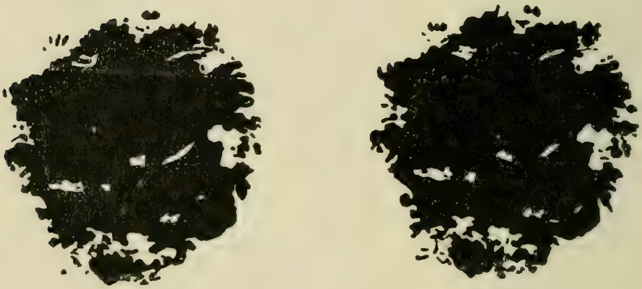
125,000 Lbs.
Av. Pressure per
Sq. In. 119.047 Lbs.
Area 1.05 Sq. In.

130,000 Lbs.
Av. Pressure per
Sq. In. 117,117 Lbs.
Area 1.11 Sq. In.



135,000 Lbs.
Av. Pressure per
Sq. In. 119,469 Lbs.
Area 1.13 Sq. In.

140,000 Lbs.
Av. Pressure per
Sq. In. 130,434 Lbs.
Area 1.15 Sq. In.



145,000 Lbs.
Av. Pressure per
Sq. In. 123,931 Lbs.
Area 1.17 Sq. In.

150,000 Lbs.
Av. Pressure per
Sq. In. 124,049 Lbs
Area 1.21 Sq. In.

CONTACTS BETWEEN 33 IN. CAST IRON WHEEL AND 100-LB. RAIL.

here to 37,000 lbs., which is, of course, very much in excess of anything they are putting on a car wheel, we had an average pressure of 138,888 lbs. I did the same thing with a steel wheel, both 78 in. and 36 in. diameter. The 78-in. piece was taken from the driver of a locomotive. There was a little difference in area, due to the variation in diameter, but between the limits of car wheels ordinarily used, 33 in. to 36 in., the diameter apparently makes no difference as far as the area of contact between the wheel and the rail is concerned as to diameter. It depends more on the condition of the wheel than anything else.

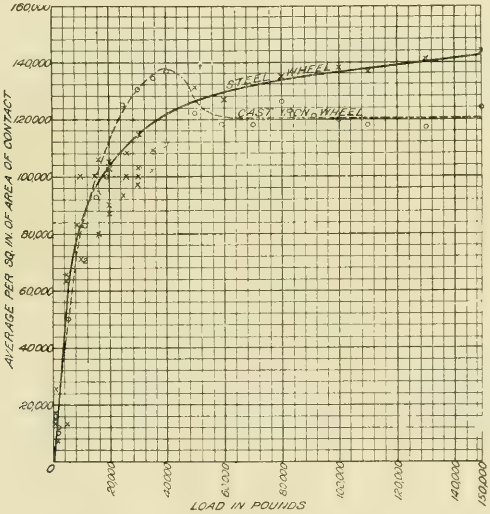
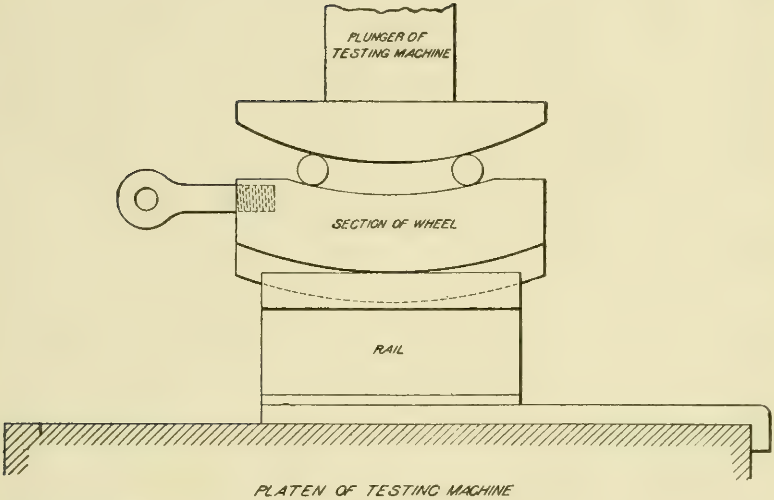


DIAGRAM SHOWING THE RELATION BETWEEN WEIGHTS ON WHEELS, AND THAT ON THE AREA OF CONTACT BETWEEN THE WHEEL AND THE RAIL.

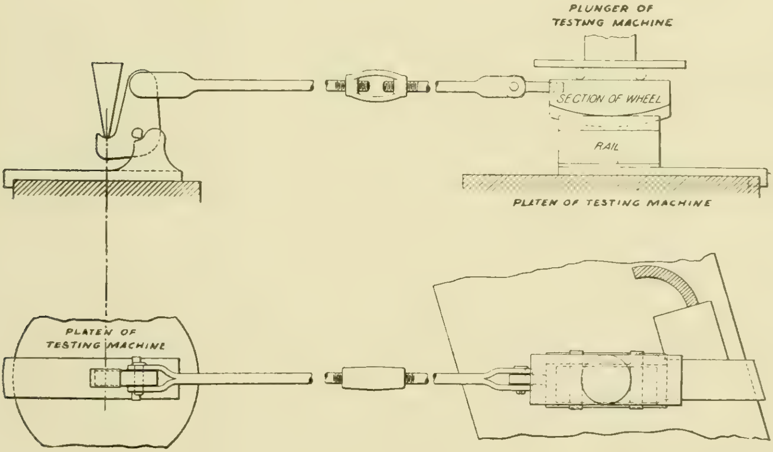
The surprise came in when I made a comparison between what was done by the cast iron wheel to the rail and what was done by the steel wheel. I may say this, however, that when a load of 20,000 lbs. has been put on a wheel the rail has been indented so that it can be seen. That was checked two or three times and checked by an independent observer, so I feel very confident in asserting that 20,000 lbs. of static load put upon a car wheel will make a depression in the rail which can be seen. It is another thing to measure it, but it is there and it can be seen, especially if pains are taken to polish the tread of the wheel and the top of the rail. With an ordinary rough rail and rough wheel it can be seen although not quite so distinctly. That means that, under the ordinary load of 100,000 lbs. capacity car, the elastic limit of the material of the rail has been exceeded and it is being crushed. The peculiarity of the cast iron and steel wheels is shown by taking these areas of contact and plotting them in the two lines of the diagram. One shows the cast iron and the other the steel wheel. Up to a load of about 27,000 lbs. actual load, which corresponds to a pressure of about 100,000 lbs. per square inch of area of contact, the material holds up; but then it begins to yield, and then yields more and more until the line carries out pretty nearly straight, and the yield is about as rapid as the increase in the application of the load. On the other hand, the cast iron climbs clear up into the air and then suddenly seems to give way entirely, and the diagram drops down to about 20,000 lbs. per square inch of area and follows along in a practically parallel line. That seems to show that the cast iron wheel for excessively high loads is harder on the rail than the steel wheel.

There is a reason for it. The tread of the cast iron wheel is absolutely unyielding, so that all the yielding is in the rail, and when a load is put on the rail in that way, of course it breaks down more rapidly than it would if part of the yield were in the wheel, as it probably is in the steel wheel. That is a surprise. I have no data to show that the steel wheel yields at all, or that the cast iron wheel does not yield. But taking the characteristics of the two metals into consideration, I do not think it is an unreasonable supposition. The loads were run up in the laboratory to 150,000 lbs., which was the limit of the capacity of the testing machine, expecting to crush the cast iron, when as a matter of fact it made no impression on it whatever, for the cast iron stood up to the load and I could not find by carefully examining it under the microscope, that there was the slightest particle of permanent set either in the cast iron or the steel tired wheel after having been subjected to that exceedingly heavy load.

In addition, a further series of experiments was made to determine the relative coefficients of friction of the cast iron and the steel wheel, to sliding on the rail. There are two kinds of sliding that a car wheel experiences nowadays, because of its use in electric service as a driving wheel. One is a spinning



ARRANGEMENT OF APPARATUS FOR TESTING THE FRICTIONAL RESISTANCE OF CAR WHEELS TO SPINNING.


PLUNGER OF TESTING MACHINE
SECTION OF WHEEL
RAIL
PLATEN OF TESTING MACHINE
PLATEN OF TESTING MACHINE

ARRANGEMENT OF APPARATUS TO TEST THE FRICTIONAL RESISTANCE OF CAR WHEELS TO SKIDDING.

action due to the wheel revolving faster than the car is moving, and the other is a skidding action due to the stoppage of the rotation of the wheel while the car is in motion over the track. In order to reproduce this action in the laboratory the two pieces of apparatus shown were used. The wheel and the rail are put in here. In one case the top part is cut out so as to be concentric with the tread, and the plunger comes down on it with a bearing piece that is also cut concentric, allowing for the difference in radius, the two being separated by two rollers so that the slight motion of the head due to pulling on the eye bolt would turn the wheel on the rail as though it were spinning and keep it in place. The other one is held down as in the lower figure and the rollers were put above it and it is simply pulled straight. We used two testing machines. With one I put the load on the tire and used the other to measure the pull, which was done by a simple bell-crank arrangement with a wedge-shaped plunger coming down on it, and the very instant there was a slip in any way the beam of the pulling machine would drop, showing that the friction of motion was very much less than the friction at rest, but there the experiment stopped, as it was the friction at rest that we were after.

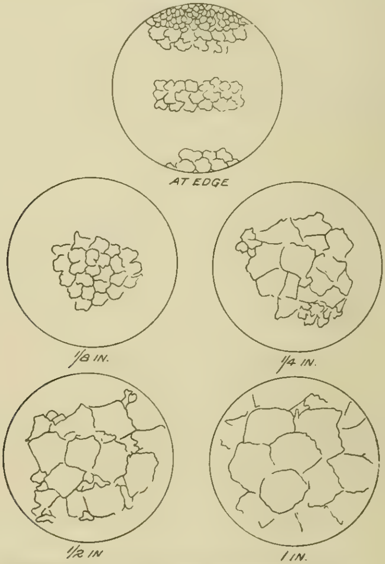
To go back a moment from this apparatus to the abrasion tests, we found that the cast iron wheel abraded under the emery wheel about four times as rapidly as the steel wheel.

In these tests here after the wheel had slipped there was a flat spot on both the steel tired and the cast iron wheel, and by measuring it very carefully and calculating the amount of metal removed, both having been subjected to identically the same load, the result was that there had been about four times as much metal removed from the cast iron wheel as from the steel wheel, showing that that abrasion corresponded pretty closely with the abrasion test on the emery wheel.

That was checked in another way, by taking the time that was required in the shop to grind off flat spots of apparently about the same size from the steel and the cast iron wheels. And here is a point where many of you may have had different expereince; but in that case it took about four times as long to grind off the steel wheel as it did the cast iron wheel, showing that those three points checked as far as that is concerned. That is a point, of course, where experience may vary very widely.

I found that in the matter of frictional resistance of the wheels there was a considerable drop from 2,000 lbs. up to 15,000 lbs. in the coefficient of friction and that the coefficient of friction for both spinning and for skidding was greater with the steel wheel than it was with the cast iron wheel. Laying aside the difference in the coefficient of friction due to the dissimilarity of the materials, it seems that this checks back in a way with those spots showing the area of contact. When the cast iron wheel is put upon a rail and its area of contact taken the whole depression is apparently in the rail itself. Now if that wheel is turned around on that same place there is no further deformation of material necessary in order that the spinning may contiue. It is in a pocket in the top of the rail and the wheel simply turns around in it. On the other hand, if my supposition is true that the steel wheel is deformed as well as the rail, then when the steel wheel is turned around there must be a continuation of that deformation clear around the wheel in a sort of wave, with the result that the resistance due to that must be greater than in the case of a cast iron wheel where there is no such deformation and wave generation. In regard to the skidding practically the same thing holds true. The cast iron wheel makes a deeper depression in the rail for the same area of contact than the steel wheel, and all of the depression is in the rail, with the result that as the wheel is moved along over the track the wave is carried on ahead of it and the resistance is greater than where there is a low wave in the rail and none at all to be carried forward in the steel wheel, so that the resistance is less for the steel than the cast wheel for low pressures.

Further, it is the experience of most people that the steel wheel is not so apt to have a flat spot developed in it as the cast iron wheel. In this there may be variations of experience, but for most railroad men that seems to be the case. This corresponds very closely with what we have seen already. In order to test the matter we put a cast iron wheel and a steel wheel on the same axle, put double brake shoes on, loaded the car until we had about 24,000 lbs. on the wheels themselves, set up the brakes so that the wheels could not turn and hauled the car up and down a piece of track about 1,800 feet long. When the car was moved at a speed of about 3 miles an hour there was a spot developed on both cast iron and steel wheels which when we took the area and calculated the amount of metal removed, checked almost exactly with the abrasion tests on the emery wheel. That is, there was about four times as much metal removed from the cast iron as from the steel wheel. But when the speed was increased up to 12 miles an hour the case was directly reversed; the metal became excessively hot and that of the steel wheel pealed off at a rapid rate, while the cast iron wheel, though it had a bad spot developed on it, did not abrade to the same extent, showing that heat has apparently a great deal to do with the production of a flat spot due to skidding. The metal in the steel wheel will go more rapidly than the cast iron wheel up to a certain point. The moment the cast iron wheel got half way down through the chill it began to go in a way that would have gone clear through the tread if it had been kept up any great length of time.

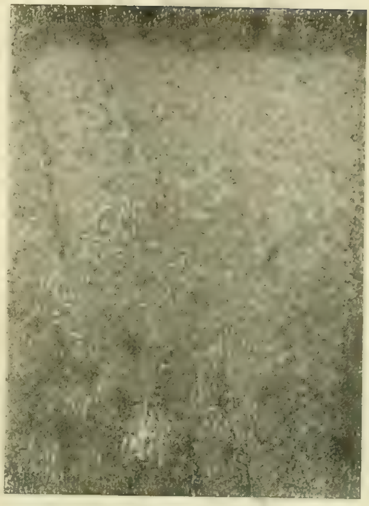


INTERPRETATION OF GRAIN STRUCTURE IN SCHOEN WHEEL AT VARYING DISTANCES BELOW SURFACE OF TREAD

These facts were determined simply to show what was done, in order to ascertain what it is necessary to do in order to make a solid steel wheel that should have all the characteristics of a first-class steel tire and yet be of such shape and character that it could be used for the high capacity freight car.

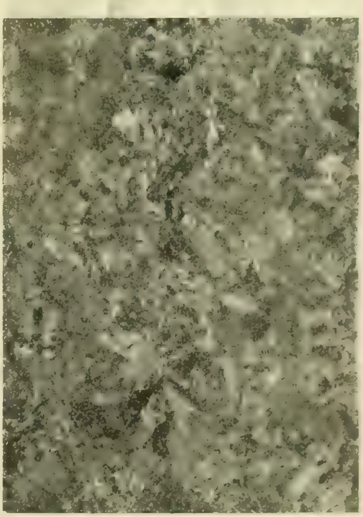
A further examination of wheels and tires upon the market was made with the microscope in which the character of their structure was determined. From this it appeared that the low

No. 31. At Edge of Tread.



No. 32. At Edge of Tread.

No. 33. ⅛ in. Below Tread.



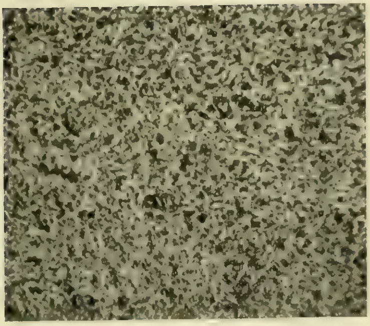
No. 34. ¼ in. Below Tread.

MICRO-PHOTOGRAPHS OF SCHOEN STEEL WHEEL.

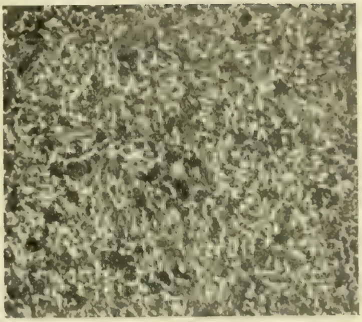
carbon D tire showed a remarkable uniformity of grain, an abundance of ferrite and careful heat treatment. Others showed a greater variation of grain size as the metal was penetrated, reaching a maximum of size at about 1 in. below the surface. Where there was no mechanical treatment subsequent to the last heating the grain was the coarsest in proportion. In the case of the "A" tire and the Schoen steel wheel, which had the highest carbon content, the grain was exceedingly difficult to photograph, so that a sketch was made showing the coarsening of the grain as the metal was penetrated. In the case of the Schoen wheel it was found that there were bands of this fine grained metal due to the several heat treatments and the work that had been put upon the wheel. That is illustrated by the diagram. The successive amount of work put upon the wheel developed these spots, and it is curious that they coincide very closely with the examination with respect to the specific gravity. We took small buttons from various depths and determined the specific gravity very carefully and found that for all of the steel tires was a little higher at the tread than at the center, tapering off down toward the center of the tread and then showing a tendency to increase. This same thing shows with the solid steel wheel with the exception that instead of tapering down regularly it is slightly wavy. It would drop a little and then rise, but not quite up to the point where it was, and then drop down gradually in a wavy line to the lowest point.

There was another point in these investigations, and that was to ascertain something in regard to the cause of the shelling out of the steel wheel. The photographs show samples of tires obtained from different roads and photographs of sections cut from every tire on the market. Samples of wheels that had failed by shelling out were taken and micro-photographs made, and these show spots and cracks of a similar character all the way through and are undoubtedly due to the presence of slag in the interior of the metal. It occurred not only immediately under the shelled-out spot, but all through the tire. While we took pains to pick out particularly the spot of the tire that was perfectly sound apparently, cutting down into it we found just such traces of slag as before.

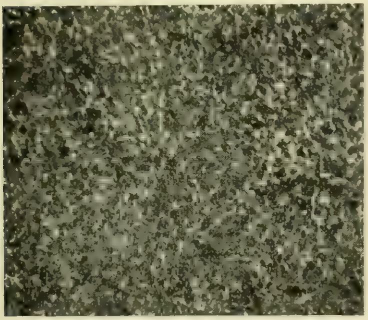
And finally we come to some cases of burned metal where



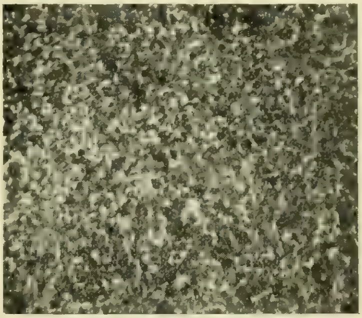
No. 1. At Edge of Tread.



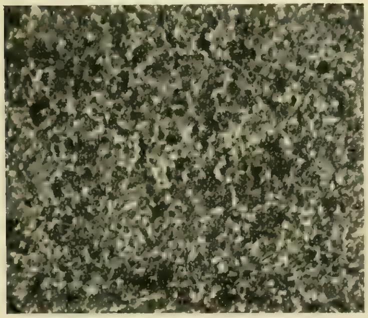
No. 2. ⅛ in. Below Tread.



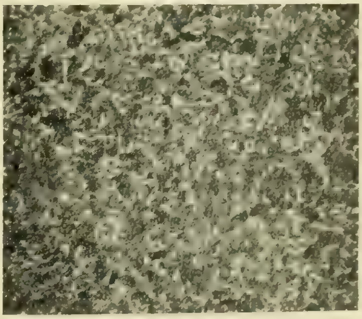
No. 3. ¼ in. Below Tread.



No. 4. ½ in. Below Tread.

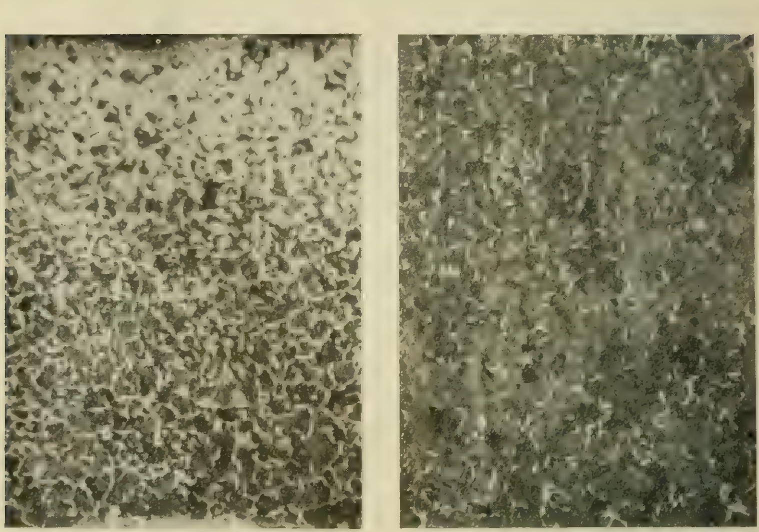


No. 5. 1 in. Below Tread.



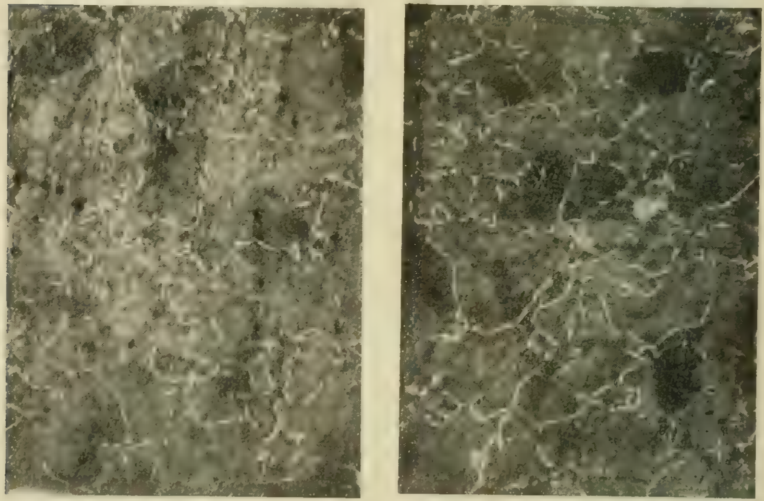
No. 6. 1 in. Below Tread.

MICRO-PHOTOGRAPHS OF D TIRE.



No. 7. At Edge of Tread.

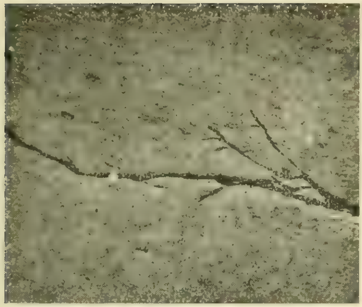
No. 8. ⅛ in. Below Tread.



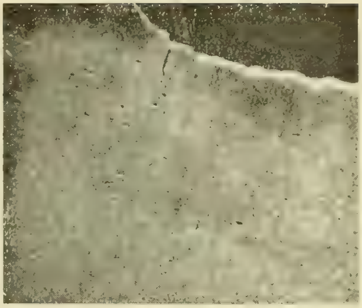
No. 9. ½ in. Below Tread.

No. 10. 1 in. Below Tread.

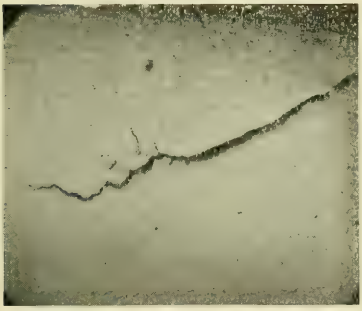
MICRO-PHOTOGRAPHS OF C TIRE.



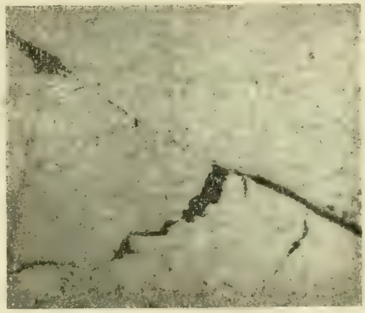
No. 51. Slag Crack Near Edge of Shelled Out Spot.



No. 52. At Edge of Shelled Out Spot.



No. 53. Slag Crack Near Edge in Solid Metal.

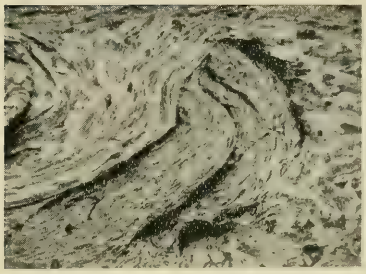


No. 54. Slag ¼ in. Below Tread in Solid Metal.

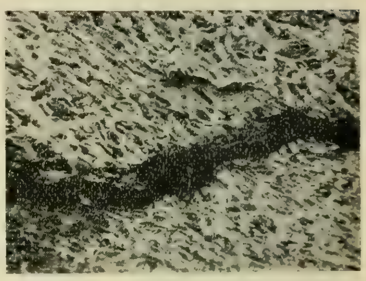
MICRO-PHOTOGRAPHS OF SHELLED-OUT D TIRE.

it shelled out. From this it must not be presumed that there is nothing else that will cause shelling-out than burning of slag, but certainly these two are very capable of producing that kind of results.

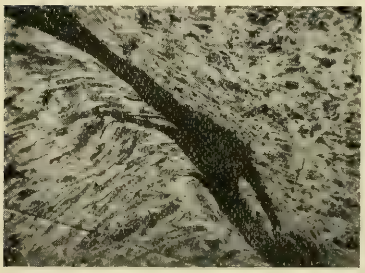
Finally the question comes up in regard to the use of the rolled steel wheel for high capacity cars and for electric service as to its economy and its adaptability for the work which it has to do. In the electric service for ordinary city work the rolled steel wheel is taking the place of the cast iron wheel, for two reasons. One is that it enables the cars to stay out of the shop for a longer period without coming in for wheel repairs. That is a matter of importance in large cities where storage room is



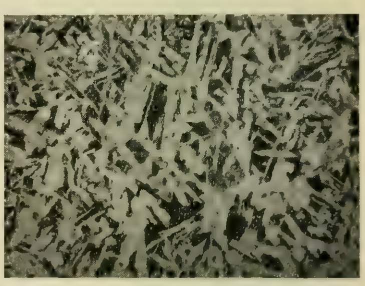
No. 55. At Edge of Shelled-Out Section.



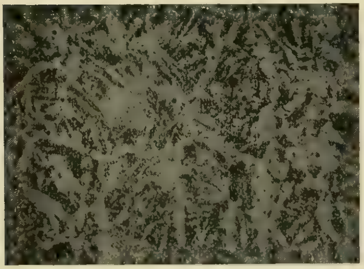
No. 56. 1-16 in. Below Tread of Shelled-Out Section.



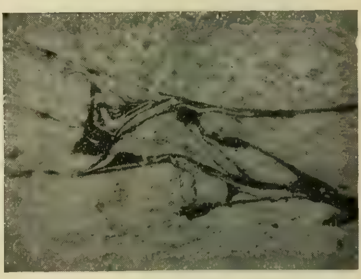
No. 57. Slag at Edge of Solid Metal.



No. 58. Structure ½ in. Below Tread.



No. 59. Structure at Edge of Tread.



No. 60. Slag at Center of Tread.

MICRO-PHOTOGRAPHS OF SHELLED-OUT E WHEEL.

of great value, so that it is worth a good deal to be able to keep the cars out on the track. For that reason the New York people, for instance, show that it is well worth their while to pay more for an ordinary steel wheel to save that storage time than it would be to go to the expense of changing the wheels whenever it is necessary to do so on account of the cast iron wheel shelling out or otherwise failing. Under high capacity cars it is a question of safety, and at the same time the expense should be considered.

After having made an examination of the various metals of the several wheels the question as to what they are doing in service is, of course, an interesting one. And there have been a number of comparative trials made in which it was shown that the rolled steel wheel is fully equal in service to what is being accomplished by the steel tired wheel. Taking this as a fair example of what can be done with these wheels in heavy passenger service, the following record is given of a test made on wheels placed under a postal car running out of New York:

As a fair example of what has been done with these wheels in heavy passenger car service the following record is given of a test made on wheels placed under postal car No. 6545, running on the Pennsylvania Railroad between New York and St. Louis: The car weighed 154,000 lbs., carried on two six-wheel trucks, giving a weight per wheel of 12,833 lbs. The wheels under this car ran 184,539 miles with a wear ranging from .348 in. to .378 in., an average of ,365 in. The mileage per 1-16 in. of wear was 25,618. The tread was maintained at all times in smooth condition and the wear on all of the wheels was remarkably uniform and even.

Twelve pairs of wheels from the same lot were placed under one truck each of four postal cars on various runs. The average mileage of these wheels up to the time of first turning was 109,018, with a minimum of 87,375 miles and a maximum of 141,170 miles. The pair of wheels giving this maximum mileage were worn .3185 in. and .2785 in. respectively. An average wear of .2597 in. in 109,018 miles was obtained from all 12 pairs, which is at the rate of 419,703 miles per inch or 26,231 miles per 1-16 in. of wear. If the amount of metal removed by turning is added to the actual wear these figures are reduced to 234,202

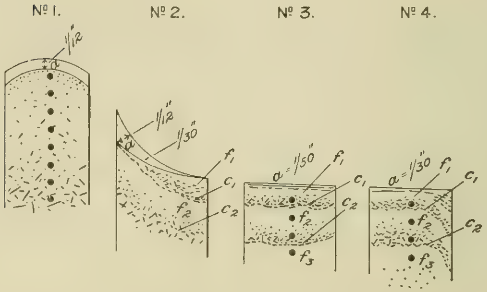
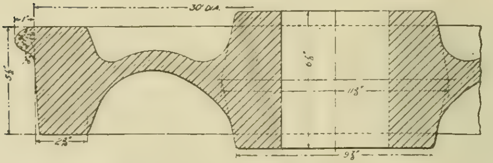
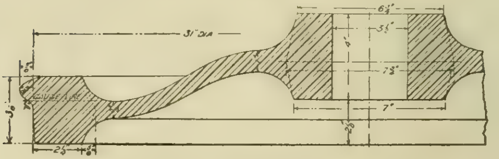


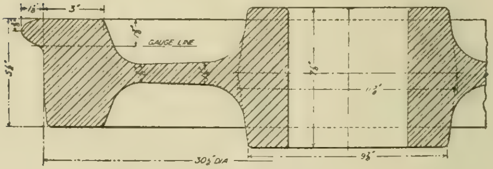
DIAGRAM ILLUSTRATING GRAIN STRUCTURE OF SCHOEN STEEL WHEEL.



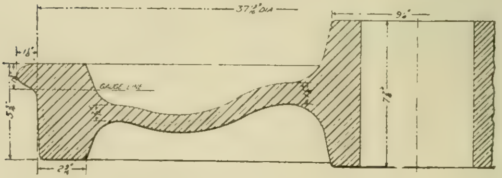
30 IN. STEEL WHEEL FOR PONY ENGINE TRUCKS.



31 IN. STREET CAR WHEEL.

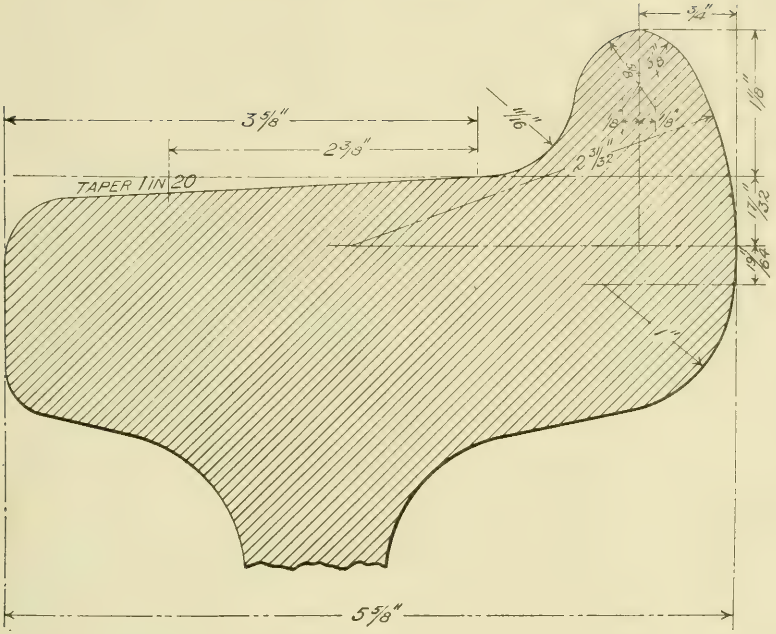


30½ INCH ENGINE TRUCK WHEEL.

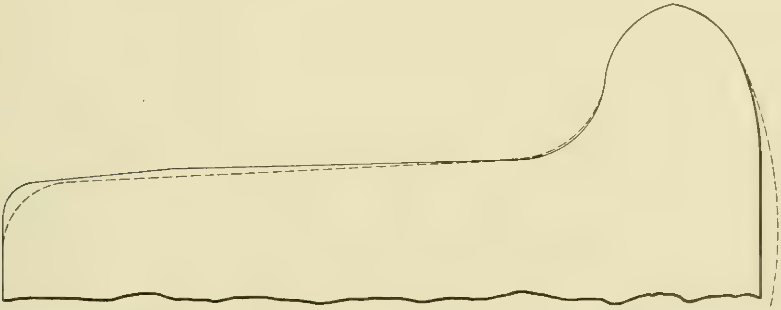


STANDARD ROLLED AND PRESSED WHEEL.

Samples of Schoen Solid Steel Wheels.

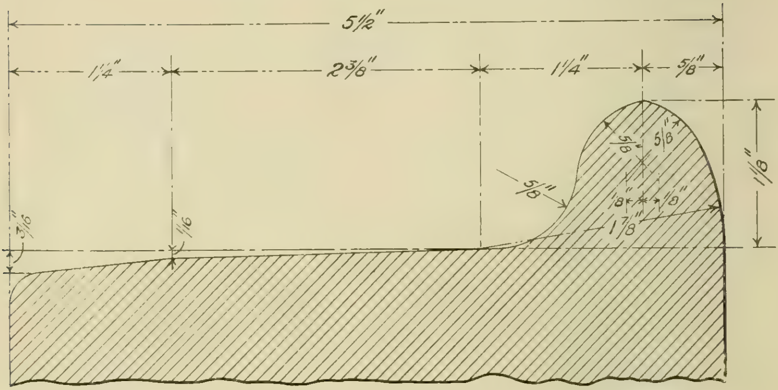


Master Car Builders' Tread and Flange, Recommended Practice.



Master Car Builders' Treads and Flanges. Standard Tread Solid Line, Recommended Practice Dotted Line.

miles per inch and 14,638 miles per 1-16 in. of wear. The causes of removal of these wheels were 3 pairs for worn treads, 3 pairs for cut journals, 1 pair for a loose wheel, 1 pair for a thin flange and 3 pairs for hollow and built-out flanges. At the time this



Master Car Builders' Standard Tread and Flange.

record was taken the remaining pair of wheels had not been removed.

In the case of electric roads the wear in passenger service runs about 6000 miles to the 1-16 in. of wear, and that is being duplicated every day in regular service.

Now it is a very difficult thing to estimate mileage and cost of freight car wheels because of the incomplete records that are kept in connection with that part of the work, but from the best statistics available it appears that the mileage obtained from cast iron wheels under 100,000 capacity cars is between 25,000 and 30,000 miles. From the tests made of Schoen solid forged and rolled steel wheels under postal cars on the Pennsylvania Railroad it was found that there was obtained an average mileage of 14,638 per 1-16 in., including wear and turning. Under heavy tenders, the mileage average 7000 per 1-16 in. of wear and turning. The average of these two figures, 10,800 miles per 1-16 in. of wear and turning, may be taken as the probable average service which can be obtained from these wheels under high capacity freight cars. The wheels furnished to the Pennsylvania Railroad for freight cars have a rim 2 in. thick with limit groove for wear cut ¾ in. in from the inner edge. This gives a wearing thickness of 1¼ ins. available for service. At 10,800 miles per 1-16 in. of wear, the total mileage which can be obtained from these wheels is 20 x 10,800 = 216,000 miles as against 30,000 miles for cast iron wheels, or a little more than seven times the life.

It seems fair to assume that the mileage would be somewhere in the neighborhood of 10,000 miles per 1-16 in. of wear under heavy capacity freight cars. If this is reduced to comparative work and the amount of metal available in the wheel for wearing out, it appears that a steel wheel ought to outlast about seven cast iron wheels. It is a mere matter of arithmetical calculation as to whether the steel wheel under these conditions is an economical proposition or not. The wheels, as you all probably know, are made out of plates, of which characteristic illustrations are given.

I have not attempted to formulate any theory, but simply to state the results of a number of these experiments as being interesting and as indicative of what still remains to be done in the way of determining what we must expect from railroad dynamics. And I wish to lay especial emphasis on this work of the car wheel under high capacity cars. It appears from what I have shown, I think, that we ought to allow for at least 30,000 lbs. flange pressure on those wheels. What we have to allow for the vertical tread pressure I am quite unprepared to say. But this I do know, a number of years ago some experiments were made to determine the thrust of the load which was put upon a truck bolster when the car was in motion, and it was found that it was from 30 to 50 per cent. in excess of the static load. That is, if we had a load of 20,000 lbs. on the bolster we were likely to have a blow as an excess load amounting to 30,000 lbs. put upon that bolster when it is in motion. That would occur especially on a rough track. But if the track is in first class condition, where the car is running perfectly smooth, we got results showing an excess of about 20 per cent. And the load on the bolster is very much less on a limber bolster in comparison with a stiff one. That checked off mile after mile on a run where we had two bolsters at opposite ends of the same car running over the same track and at the same time and loaded with the same amount. But laying that aside, we must provide for at least 50 per cent. in excess of the static load on the car wheel when the train is in motion, because it seems perfectly reasonable that if we get 50 per cent. excess on the bolster we have at least as great an excess on the wheel that is down on the rail and is not eased off by springs in any way.

So that with a car wheel under a load of 20,000 lbs. and running over the ordinary track and likely to wander away from home and get on all sorts of curves, it seems as though it is reasonable to expect that that wheel must carry at least 30,000 lbs. vertically and 30,000 horizontal thrust on the flange. And whether it is safe to do that or not with cast iron wheels depends entirely on what the railroad man considers to be a fair factor of safety and a risk which is profitable to incur.

PRESIDENT: Gentlemen, I think you will all agree with the Chair that I do not know that we have ever listened to a more interesting address, and interesting because based on such thorough and exhaustive experiments. The subject is now open for discussion. I think Mr. Slocum is here. May we hear from him?

MR. A. W. SLOCUM: I want to say that I have enjoyed the paper very much. There are a good many figures which are arrived at which give a different conclusion from that which many of us had come to from actual experience. But they are actual tests, taken carefully, and give a good deal of food for thought.

Some of his comparisons are hardly fair. It is natural that you have more cast iron wheels than steel wheels break, when you come to think of the large number of cast iron wheels compared to steel which are in service; and giving pictures of wrecks is hardly a fair thing unless some one has been on the spot and made an examination just before the wreck. Sometimes things go wrong with the rail or the bridge, or their connecting parts, or a loose nut for instance permitting a spread. But the entire paper all the way through is very interesting and I am glad to have had a chance to have heard it.

MR. A. STUCKI: I am very glad to have been here to-night and to have had the opportunity to listen to such an interesting and well-prepared subject. I can actually add nothing to it. However, I would like to ask a question or two regarding the lateral force coming on the wheel flange, and in order to be better understood, will make a few remarks first.

The pressure recorder described gives the lateral force on the rail. This, however, is not what breaks the flange of a wheel. It is the pressure that exists between the rail and the flange which does the damage.

If you had the rails on said curve covered with boards and a ball rolling at 36 miles per hour, it would roll around the circle without exerting any pressure outward nor inward. Supposing you could have a car supported in the same way, it also would go around the circle, the same as the ball, no matter what the weight of the car might be.

Unfortunately we have no trucks as flxible as that, and as soon as we approach a curve the natural tendency for them is to go right straight ahead with the car until they get swung inward by the wheel flanges. Let this force be called the swiveling force. It is registered by the pressure recorder just mentioned and is depending on a good many conditions.

For example, with an ordinary side bearing this force is great, while an anti-friction side bearing will reduce it a very large extent.

Again, a heavy truck is harder to swing around than a light one. This holds especially true if the weight acts at a distance from the centre plate, and for this reason heavy pedestals, heavy journal boxes and heavy wheels will tend to increase the blow every time the flange strikes the rail, and it is evident that even from this point of view great consideration should be given for selecting the materials for these details. Supposing we had a truck without any weight at all, it could be swung around with comparatively little force.

Another item influencing this swiveling force is the flexibility of the truck around the column bolts, looking down in plan view. The outer rail is naturally the longest of the two, and the wheel on it soon will be back of its mate. This puts the axle on an angle and allows the outside wheel to run gradually on a larger diameter of the cone, catching up partly without slipping. The ordinary arch box truck, as a rule, has enough freedom to make such an automatic adjustment possible.

I now would like to ask Mr. Fowler just what conditions existed on the car he tested.

As soon as the speed of the car exceeds 36 miles per hour the centrifugal force, as pointed out by Mr. Fowler, would also make itself manifest and would have been registered on the pressure recorder had the car ever obtained this speed. This is the second force acting on the wheel flange.

The third force on the flange, however, is not recorded. It takes place between the rail and the flange and is very great at times. We may call it the pinching force, and it is produced as follows: As soon as the wheel flange is hard against the rail the curvature of it will force the flange inward, but the friction between the tread and the rail top grip the wheel so tight that the pressure against the flange must be enormous before the wheel lets go its hold, especially at high speeds, when most of the load comes on the outside rail. This pinching force, in addition to the swiveling and centrifugal forces already mentioned, will naturally run much higher than the lateral forces registered by the pressure recorder.

For this reason I would like to find out from Mr. Fowler whether he obtained the 30,000 lbs. from the readings of his apparatus, or whether he, knowing what it takes to break the flange of a chilled wheel, arrived at this figure by working the other way and allowing a certain coefficient of safety?

MR. J. C. WARNE: I have listened with a great deal of pleasure to the very able paper read here tonight illustrating the merits of the cast iron wheel, the steel wheel and the newest product which we have before us, the Schoen rolled steel wheel. I can talk more along the line of the cast iron wheel and will say, "The devil is not quite so black as he's painted," though I must say the speaker did quite a lot of justice to the cast iron wheel. As most of the railroad men here know, there has been a very great improvement made in the tread and flange contour of the cast iron wheel. I have no doubt that those experiments conducted by the speaker were made from wheels having the old contour tread. Isn't that so?

MR. FOWLER: Yes.

MR. WARNE: The old M. C. B. contour had 1-16 in. cone taper, which Mr. Stucki spoke of, whereas the new contour taper which has been adopted by the M. C. B. A. is 1 in 20 or about ⅛ in. What led to the change? Simply that the Pennsylvania and the B. & O. (I think they started it) found that an increased cone or taper in the tread of the wheel reduced flange breakages from 50 to 60 per cent., if I am rightly informed.

Now, as to car wheel mileage, if the gentleman were a car wheel manufacturer he would know that the car wheel makers have to guarantee a mileage of 60,000 miles or four years' service, and in some cases 70,000 miles or five years' service. If the wheels ran 30,00 miles only the manufacturers would soon be out of business because their replacements would be too great. The cast iron wheel will be here, I think, for a good many years to come. And why? I do not want to depreciate the Schoen steel wheel a little bit. It is a fine wheel. But being in the cast iron wheel end of the argument I think the Schoen steel wheel will do the steel tired wheel men more harm than it will us.

For 60,000 and 80,000 capacity cars nearly all cast iron wheels are used. The argument of the speaker did not depreciate the cast iron wheel very much for these sizes of cars. But I am free to admit that for the larger capacity cars (and 120,000 lbs. capacity is talked of) the Schoen steel wheel may possibly take its place. But here is another factor. You know we are a practical people and get down to dollars and cents in our costs. Think of the millions of cast iron wheels under cars in the United States today. Imagine the cost of equipping even the heavy capacity cars with steel wheels. Will the railroads stand for the cost of the change? The commercial side of the argument (which largely governs the case) has another point in its favor. The cast iron wheel after it has done its mileage and goes to the scrap pile is worth 50 or 55 per cent. of its original value. What is the value of the steel wheel when scrapped?

I don't know but the scrap value is always a powerful argument when you go to the purchasing agent for his orders. So I think that the cast iron wheel, with the additional coned tread which has been found to help the flange so much, will be here to stay. I have nothing to say against the steel wheel as manufactured. But whether it will be finally adopted for universal use is to me very doubtful for the reasons I have mentioned.

PRESIDENT: We would like to hear from Mr. J. H. Baker.

MR. JAS. H. BAKER: I have nothing to add to the paper except two or three suggestions, and you can take them for what they are worth.

Ten years or so ago I started a forge and wanted business. I saw the first hopper steel cars made and I at once concluded that there was my place for business. We all know generally the advantages of a steel car; first, that it can be dumped and unloaded in a minute, as compared with the cars we had before; next, because it is made to carry a great weight compared with its dead load. And next I thought I saw a great industry, because when those big steel cars go up against the little wooden ones in a smash they would knock the little ones out as easily as the sheep's head butted the dumplings out of the pot. Experience, I guess, shows that I was right.

About the steel wheel as compared with the cast iron wheel, I would like to differ from the gentleman who spoke last about the millions of wheels and their cost. It comes to a very simple proposition in the last analysis, and that is, what service will the railroad men get for their money invested in wheels. Two or three incidents will illustrate what I think about the cast iron wheel and the steel wheel, comparatively. When they have reduced the cost of steel wheels to what it ought to be, as Americans will do, it is about like a story you have heard:

Little grains of powder,
Little drops of paint
Make a girl's complexion
Look like what it 'aint.

That is just what the cast iron car wheel will look like in the course of time. It may be a long time, but it is coming. In other words,

Mary had a little lamp,
Its wick was trimmed just so;
And everywhere that Mary went
That lamp was sure to go—out.

And that will be the case of the cast iron wheel for high-class service, in my humble opinion.

Now, then, I want to recite a piece of beautiful poetry showing where I believe the cast iron wheel will land eventually. A verse of simple poetry which voices a beautiful sentiment that I can hardly express—

> I stood upon the sandy shore,
> The tide was full and high,
> And my enraptured gaze beheld—
> A dead horse floating by.

MR. A. W. SLOCUM: The claims that the steel wheel people make in a good many ways I think they are going to make good on, but there is another factor about the cast iron wheel which is not considered very seriously at the present time and which should be considered. The steel people say we will furnish you a wheel that will make so many miles for so much money. Its scrap value when it is thrown out is not very much. The cast iron proposition ordinarily is on similar lines except that the scrap cast wheel commands a high price, but when the railroad man comes back at us and says we want the steel wheel because it will make more miles and we think it is safer, our answer is, if you want to pay the price we can give you a cast wheel, as has been demonstrated for a good many years, for ten or fifteen years at least, that will make as many miles as that of any steel wheel ever produced, and will give you the strength, but you have got to pay the money for it. You must not forget that there are other elements now entering into cast wheels besides iron, carbon, sulphur, phosphorus and manganese. Scientific and intelligent advance has been and is still being made in the mixtures for cast wheels, largely through the introduction of alloys; the prominent ones at the present time being vanadium and titanium; the latter has especially been used in conjunction with cast wheels with wonderful results. These mixtures naturally increase the cost, and this increased cost has been largely prohibitive; prohibitive only in the sense, however, that the railroad man apparently cannot bring himself to the point of paying so much for cast iron. But cast wheels can be made, there is no question or doubt of its having been done, that will average

100,000 miles, with breakages practically nothing. It is simply a question of whether you are willing to pay the price.

MR. JULIUS KRAUSE: It gives me pleasure to listen to Mr. Fowler, in discussing the cast iron and solid steel car wheel this evening. I have been looking for defective car wheels for the last forty years, and Mr. Fowler's discussion has answered questions which I was anxious to have explained during the many years that I followed in examination of car wheels.

While I cannot agree with him in his discussion of the cast iron wheel, as it is serving mankind, by carrying the farmer's products to market and bringing the many manufactured articles back to the farmer. The cast iron wheels used under 40, 50 and 60,000 pounds capacity cars are safe, while I will admit that we have a few broken flanges under 80,000 pounds capacity cars, and broken flanges under 100,000 pounds capacity cars were more frequent until we commenced controlling freight trains down heavy grades by air brakes, which have greatly reduced broken flanges under 100,000 pounds capacity cars. I must insist that the cast iron wheels are alright for the lower capacity cars, and will admit that the steel wheel is an improvement over the cast iron wheel under 100,000 pounds capacity cars; but when I listen here tonight to the cast iron wheel manufacturers, they praising the cast iron wheel and Mr. Fowler praising the solid steel car wheel, I am inclined to believe Mr. Fowler owns some solid steel wheel stock.

In conclusion I will say that the price of the steel wheel will have to be reduced before it can supersede the cast iron wheel.

MR. L. H. TURNER: Last evening a number of prominent railroad men were coming over from New York to Pittsburgh. One said to the others, "What particular feature in railroad operation gives you greatest concern?" The answer was, "The wheels under our equipment. We have had quite a lot of experience with cast iron wheels under heavy capacity cars and we have become satisfied that unless a better cast iron wheel is made we must have steel wheels. We cannot afford to haul passenger trains carrying from 200 to 700 passengers running alongside of freight trains with the liability of wheels giving out under the freight train and thereby causing loss of life and property."

The gentleman spoke about the cast iron wheel makers guaranteeing their wheels, and that if they did not make a good wheel they would lose a lot of money in replacements. Some years ago we kept an elaborate car wheel record. After sufficient time had passed it was examined to find how many wheels were failing from inherent defects, and much to my surprise the wheels that were replaced due to this cause would not pay a $30 a month clerk. But notwithstanding this the wheels do not seem to be strong enough for our heavy cars.

I would like to ask Mr. Fowler a question. In his tests I would like to know what type of center plate and side bearing was under the car that was tested. A few years ago we tested trains with frictionless side bearings and those equipped with ordinary flat center plates and side bearings, and we found that on short curves we used about 10 per cent. less locomotive energy in hauling the some trains where they were equipped with frictionless center plates and side bearings. I can show cast iron wheels under cars equipped with those devices that have been in service ten years that are good for further service, showing the fact that the frictionless center plates absorb the shock, and I am confident had the test been conducted under what we know to be the best conditions the results would have been materially different.

MR. FOWLER: The question was raised as to the character of the pressure of the wheels against the rail as measured by my instrument. It measures the lateral pressure of the wheel against the rail and from that should be subtracted the frictional resistance of the wheel on the rail before you get back to the flange. But there is always a pressure of the flange against the rail when you are on a curve perfectly regardless of what the actual weight of the car is.

Suppose we have a car with 20,000 lbs. on the wheel and assume a frictional resistance of 25 per cent. That would mean that 5,000 lbs. of the lateral thrust would be taken up by friction of the tread on the rail before you get back to the flange. On the other hand, if you were running at very slow speed you might have an actual flange pressure of less than 5,000 lbs. But there must always be a guiding pressure against the flange to carry the car around on the curve, and that is the pinching matter Mr. Stucki brought up. That pinching is a very serious matter, and it increases as you decrease the wheel base of the truck. For example, I looked into some wheels running sharp on an electric road a short time ago. They had a perfect epidemic of sharp flanges. I found they had a 5 ft. 2 in. gauge and a 4 ft. 6 in. truck wheel base, with the result that those wheels were simply cramped around on the rail and were cutting very badly. Then, in addition to that, the trucks were out of square. So that my figures will have to be reduced to a slight extent there by the frictional resistance of the wheel against the rail, but still there is an ample margin of what might be called excess pressure.

There is one point I did not bring out that is rather interesting, though not important. Those figures I showed were the figures for the leading wheel of the front truck. The pressures of the next wheel after that averaged a little lower. Then the pressure on the leading wheel of the back truck was between those two on the front truck, and the rear wheel of the car dropped down below them all. In regard to side bearings, there is probably no one thing that has so much influence on the cramping of the wheel on the rail and the wearing of the flange as the condition of the side bearings. The side bearings on the trucks we were using were ordinary side bearings, flat, with iron center plate. They were what we have been using time out of mind on freight cars, and there was about ⅛ in. clearance between those on the car and on the truck. What Mr. Turner said in regard to roller side bearings has been corroborated on another road by the fact that sharp flanges have been very materially reduced by the introduction of the ball center and side bearings, especially the ball side bearing. I think few people have any idea of the tremendous resistance offered by the side bearings to the turning of the truck. A few years ago I had occasion to investigate that matter, and it took a pull of about 700 lbs. to turn the truck under the car body with the full weight of the car resting on the truck. Then I took off the car body and loaded the truck with 10,000 lbs., so that the weight on the bearing was the same as it was before, and in turning the truck on that ball bearing that was used to carry the whole load of truck and car my dynamometer was absolutely useless and what

I used was a letter scale taken off the desk of the master mechanic, and it took, I think, about 2½ lbs. as against 700 to do the turning. There is another thing about the effect of those side bearings. It is my impression that with the ordinary side bearings and center plate the truck never squares on the tangent until it reaches a curve in the opposite direction from the one it has just left; that is, the truck runs canting across the track.

I was asked whether that 30,000 lbs was calculated from the machine or worked up backwards. It was calculated from the machine.

The condition of the truck that I used was just simply that on a car taken haphazard out of service, and the wheels, though they were in ordinarily good condition and within the limits of wear, were yet worn a little and were such as might be considered an average of service on the road.

In regard to the mileage of the cast iron wheels I think that a consultation with the passenger service of any electric road in the country will show that 30,000 miles for cast iron wheels in passenger service in electric service is high. They are usually guaranteed for 40,000 but the records are so badly kept that the railway companies can not make the claim, and 19,000 to 23,000 miles would be nearer the average, I think.

MR. A. W. SLOCUM: I spoke of railroad service.

MR. FOWLER: It has been claimed the cast iron wheel is here to stay. Of course it is. Nobody expects that the cast iron wheel is ever going to be driven out of business, any more than the horses were driven away by the use of electricity on street cars. We will always have to have cast iron wheels. They are doing elegant service up to 60,000 lbs. capacity.

The question has been asked as to which wheel slips on the rail on a curve. I think you can argue and prove that either one does, but I don't know that anybody has ever made a measurement so as to know.

MR. A. W. SLOCUM: I would move a vote of thanks to Mr. Fowler for his paper, which has taken so much time and expense and earnest investigation and has been so ably delivered, and we are very glad to have heard it.

The motion, being duly seconded, was carried unanimously.

UPON MOTION, Adjourned.

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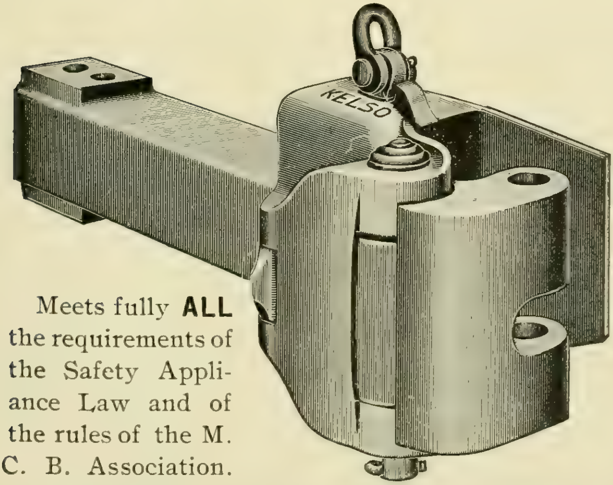

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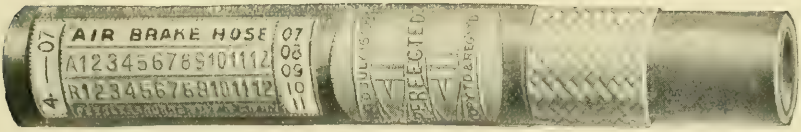

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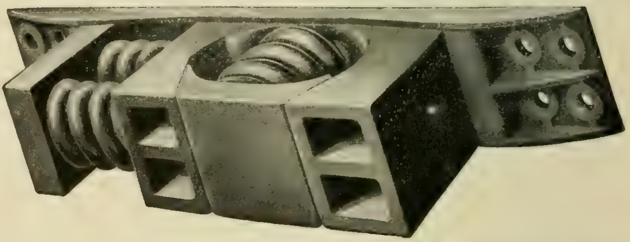

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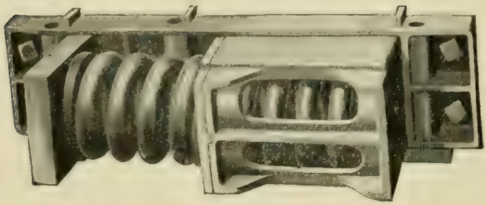

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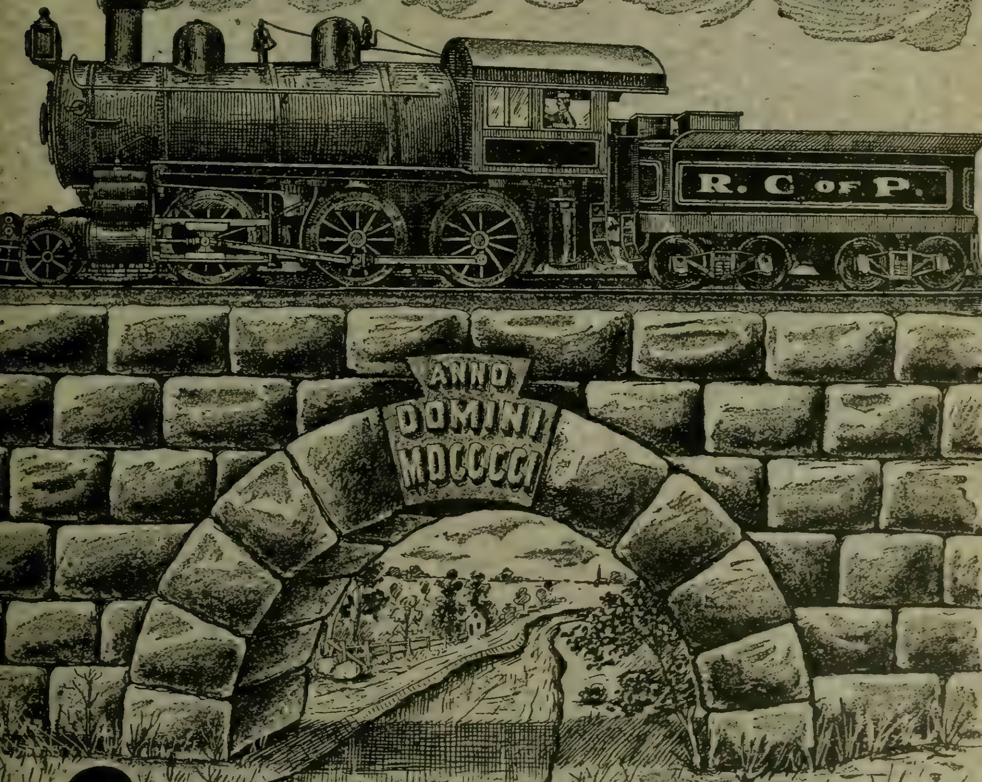

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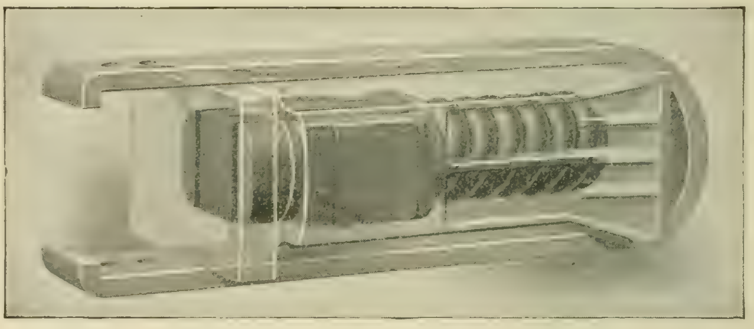

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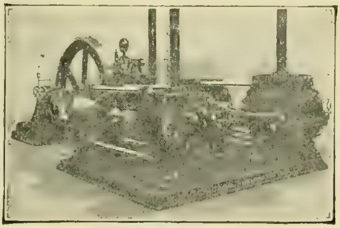

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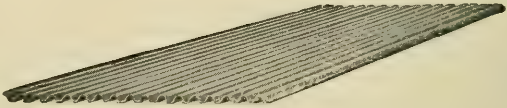

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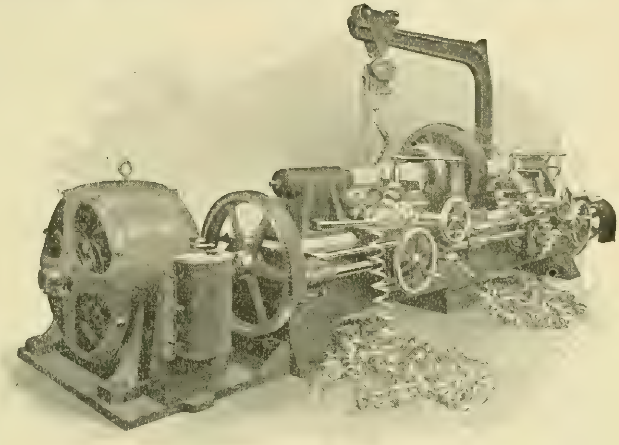

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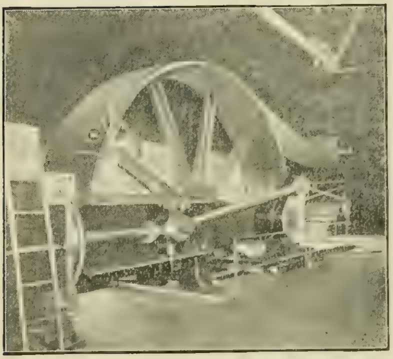

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VOL. VII.
No. 2.

Pittsburgh, Pa., Dec. 27, 1907.

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J. D. Conway, Secretary, General Offices P. & L. E. R. R., Pittsburgh, Pa.

*Meetings held fourth Friday each month, except June, July and August.*

## PROCEEDINGS OF MEETING,
## DECEMBER 27th, 1907

The meeting was called to order at the Monongahela House, Pittsburgh, Pa., at 8:00 o'clock, P. M., with President H. W. Watts in the chair.

The following gentlemen registered:

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Koch, H. J.
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Lobez, P. L.
Long, R. M.
Lynn, Samuel.
Mason, E. F.
Miller, John F.
Nickerson, S. N.
Porter, H. V.
Painter, Joseph.
Peach, W. M.
Reese, F. T.
Sanville, W. F.
Smith, D. W.
Smith, M. A.
Stafford, S. G.
Stark, F. H.
Stewart, W. W.
Stuart, Malcolm D.
Stucki, A.
Suckfield, G. A.
Summers, E. W.
Taylor, H. G.
Weisbrod, J. F.
Watts, H. W.
Wilson, W. H.
Wood, W. H.

## VISITORS.

Cain, H.
Chapin, E. S., Jr.
Christianson, A.
Clark, Chas. H.

England, Alex.
French, Roy A.
Gerber, D.
Gies, Albert J.
Gillespie, W. M.
Girdler, L. T.
Harvey, George L.
Harwood, W. C.
Hink, Geo. L.
Kelsey, Benj. F.
Klein, N. P.
Krause, Robert A.
Lundenbeck, H. C.
Lowry, R. N.
Rauch, T. T .
Ruff, J. E.
Smith, Sion B.
Streib, J. F.
Waugh, J. M.

The minutes of the last meeting being in the hands of the printer, the reading of them was dispensed with.

The Secretary read the following proposals for membership:

Chapin, E. S., Spl. Appr., P. R. R. Co., Altoona, Pa. Proposed by R. L. Kleine.

Colburn, Wm. W., Civil Engr., Pressed Steel Car Co., 3507 Fleming Ave., N. S., Pittsburgh, Pa. Proposed by Harvey A. Allen.

Gallinger, Geo. A., Res't. Mgr., Ind. Pneu. Tool Co., Farmers Bank Bldg., Pittsburgh, Pa. Proposed by J. D. Conway.

Hay, Paul L., Sam'l. W. Hay's Sons, Farmers Bank Bldg., Pittsburgh, Pa. Proposed by J. D. McIlwain.

Lowry, R. N., Mech. Engr., Arthur Koppel Co., 905 Arch St., N. S., Pittsburgh, Pa. Proposed by A. Stucki.

Rader, B. H., Eastern Sales Agent, Universal Portland Cement Co., Frick Bldg., Pittsburgh, Pa. Proposed by L. C. Bihler.

Slick, E. E., Chief Mech. Engr., Carnegie Steel Co., Carnegie Bldg., Pittsburgh, Pa. Proposed by L. C. Bihler.

Stewart, C. A., Asst. Station Master, B. & O. R. R. Co., 4738 Lyttle St., Pittsburgh, Pa. Proposed by W. F. Ryan.

Trust, J. H., Night Fore., Penna. Co., Ft. Wayne Division, 286 Jackson St., Rochester, Pa. Proposed by T. E. Townsend.

Turner, E. S., R. H. Fore., Penna. Lines, Alliance, O. Proposed by C. W. Hall.

PRESIDENT: These names will be passed upon by the Executive Committee, and the gentlemen will be notified of their admission into the Club.

If there is no further business, the next order is the presentation of the paper, a very exhaustive and very thorough paper on

# THE DRAFT GEAR.

BY MR. A. STUCKI, MECHANICAL ENGINEER.

1. There is no other detail on a car in which the opinions of the railroad men differ as much as they do in regard to the draft gear. As yet by far the largest proportion use spring gears of various designs, while others would not consider anything but a friction gear, and even here the opinions differ widely as to the construction and requirements.

2. In view of this, a few remarks on the underlying principles of the draft gear and its construction are appropriate, so that the relative advantages of the different forms can be more readily understood, with the ultimate point in view, of bringing more unison into this detail as the time goes on.

3. Bearing also in mind that fully 75 per cent of all the wooden cars on the repair tracks have to undergo work on their draft gears or attachments, too much consideration cannot be given this subject.

4. It is true, a great deal of time and money has been spent during the last twenty years by different firms and railroads throughout the country in order to bring about an effective protection for the car against end shocks. It is also true that very good results have been accomplished, and the railroads and the manufacturers are to be congratulated on this. But the methods, or rather the constructions, are so numerous and differ so radically from each other that we can not help thinking that lots of energy has been and possibly is yet being wasted in not starting in the right direction.

5. There is absolutely nothing mysterious about the underlying functions of a draft gear. It is to protect the car against end shocks as far as possible. To do this, it should absorb as much energy as possible and transform it into a gradually increasing force on the car. After the closing of the gear the balance of the energy is taken by the car directly, just the same as if the draft gear were a solid block and the intensity of the final blow depends on the yieldability of the car itself. For

instance, a steel gondola, with continuous sills, well braced by the steel floor, would register a greater blow than a hopper car with its comparatively springy sills. Again, a steel car is less yielding than a wooden one. Possibly one of the best illustrations of this was given by our late President, Mr. Stark, when at the last M. C. B. convention he explained how a baseball player is checking the force of a ball by gradually easing off the hands.

### *Momentum in a Train.*

6. The following table will show the momentum in foot pounds stored up in loaded cars, moving at different speeds:

| Speed, Miles per hour. | 60,000 lbs. Capacity Cars. Total Wt. 100,000 lbs. | 80,000 lbs. Capacity Cars. Total Wt. 125,000 lbs. | 100,000 lbs. Capacity Cars. Total Wt. 150 000 lbs. |
|---|---|---|---|
| 1 ............ | 3,314 | 4,142 | 4,971 |
| 2 ............ | 13,256 | 16,568 | 19,884 |
| 3 ............ | 29,826 | 37,278 | 44,709 |
| 4 ............ | 53,024 | 68,272 | 79,536 |
| 5 ............ | 82,850 | 103,550 | 124,275 |
| 6 ............ | 119,304 | 149,112 | 178,956 |
| 7 ............ | 162,386 | 202,958 | 243,579 |
| 8 ............ | 212,096 | 265,088 | 318,144 |
| 9 ............ | 268,434 | 334,702 | 402,651 |
| 10 ............ | 331,400 | 414,200 | 497,100 |
| 11 ............ | 400,994 | 501,182 | 601,491 |
| 12 ............ | 477,216 | 596,448 | 715,824 |
| 16 ............ | 848,390 | 1,060,487 | 1,272,584 |
| 20 ............ | 1,325,621 | 1,657,026 | 1,988,431 |

(Figured as W x $V^2$ ÷ 2G, W being weight, V = speed in feet per second, and G being 32.16.)

7. The momentum increases in direct proportion to the weight of the car, which explains why draft gears on high capacity cars, if run in solid trains, are subject to greater strains. Of course, one heavy car amongst light equipment will not suffer heavier blows than its neighbors of less capacity, while a light car in between heavy equipment gets the full benefit of the momentum. This fact is only too often demonstrated, whenever light and weak wooden cars are carried between loaded steel cars of high capacity. In this sense, the draft gears are independent of the carrying capacity or the weight of the respective cars.

8. The speed affects the momentum very much, it being increased as the square of the velocity. This fact undoubtedly helps to explain, why the conditions of to-day are much harder on the draft gears than years ago when comparatively slow speeds were considered adequate.

9. In addition to this, our engines get heavier every day, 250,000 lbs. and over against 200,000 lbs. ten years ago; this in turn enables us to get a greater draw bar pull, not seldom as high as 60,000 lbs.

10. The trains get longer and heavier, "75 loads and 90 empties" not being unusual, and in mountain districts double headers and pushers help to augment draw bar strains.

11. Since automatic couplers and steel cars are so much used, the train men do not think it necessary to handle the trains with quite as much care, at least judging from the gatling gun like noise following the stopping of a train in a classification yard.

12. True enough, the air brakes are also being perfected steadily to keep pace with the procession, but unfortunately we have not yet come to a practical graduated brake, so that the weight of the empty car is all that can safely be taken care of by the brake, while by far the greater mass—the load—remains unprovided for.

13. Some of our railroad friends claim that the gravity yard will destroy a great many draft gears, which is undoubtedly true, if the brakes do not hold. On the other hand, it must be conceded that these "humps" do away with a great deal of tugging, buffing and racking, which, beyond doubt, is much harder on the cars and engine than the regular service.

14. If two trains, both running at four miles per hour, meet, the effect is the same as if one standing gets run into by an eight-mile train. The first two cars meeting always get the greatest blow.

15. If a loaded 100,000 lbs. capacity car runs into a bumping post at a speed of eight miles per hour, the momentum destroyed must be 318,144 foot pounds. (See preceding table.)

16. If this car strikes another loaded car standing still,

the shock (considering an inelastic body) is only half as great and the two cars will proceed at half the speed.

17. If the car runs into a loaded train standing still, the blow between the first two cars is just the same, after which they will proceed at half the speed to hit the third car, etc.

18. Of course, the blow is always somewhat lessened by the amount the two adjoining gears transform into a gradual push. This holds good for spring as well as friction gears. The only difference between the two is that the spring gears, after the main shock has passed, will open up again and cause a back lash, while the friction gears are prevented from opening with the same force as what they received in closing.

19. As far as the car is concerned, there is never any

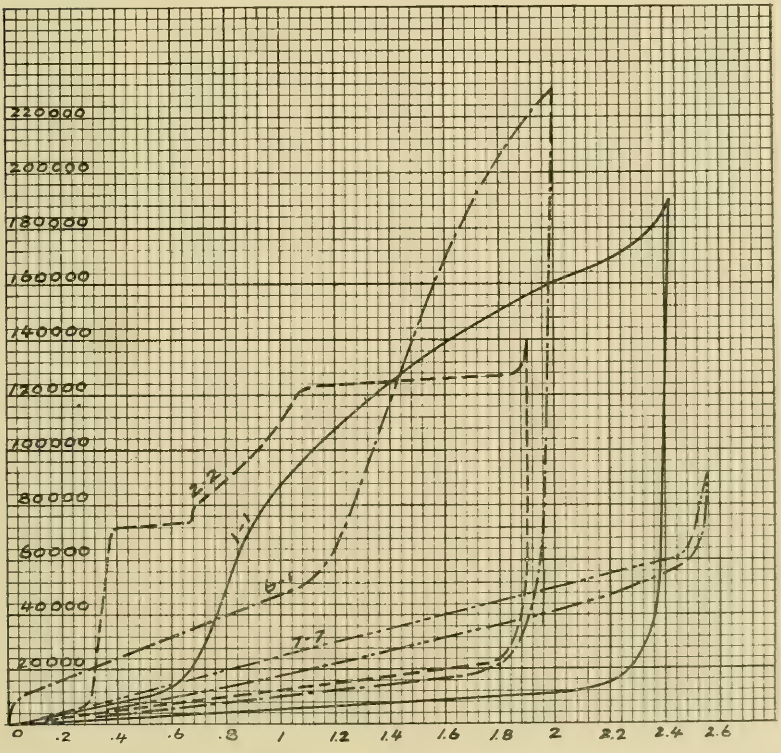


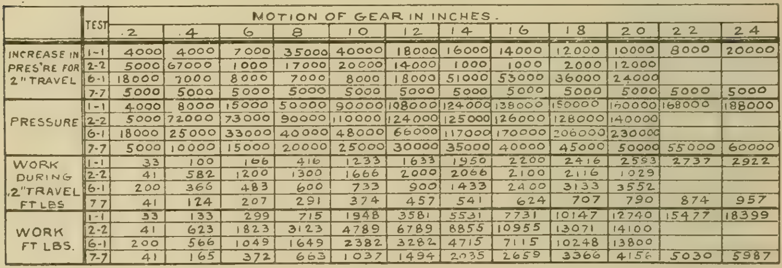
FIG. 1

energy absorbed, but as far as the gear in itself is concerned, part of the work it takes to close it is absorbed by abrasion on the bearing surfaces and part of it is transformed into heat, just the same as in grinding, or machining anything else.

### *Momentum Taken by the Draft Gear.*

20. To comprehend more fully the details of operation of an individual gear, tests made by the M. C. B. Committee in May, 1902, have been chosen and shown in Fig 1. The diagrams represent four typical draft gears, being the 1—1, 2—2, 6—1, and 7—7 tests, and in order to compare the performances more readily, the diagrams have been drawn into each other.

21. To bring out still more the peculiarities of these different gears, Table, Fig. 2, has been prepared, which is really self-explanatory.



| | TEST | MOTION OF GEAR IN INCHES. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | .2 | .4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
| INCREASE IN PRES'RE FOR 2" TRAVEL | 1-1 | 4000 | 4000 | 7000 | 35000 | 40000 | 18000 | 16000 | 14000 | 12000 | 10000 | 8000 | 20000 |
| | 2-2 | 5000 | 67000 | 1000 | 17000 | 20000 | 14000 | 1000 | 1000 | 2000 | 12000 | | |
| | 6-1 | 18000 | 7000 | 8000 | 7000 | 8000 | 18000 | 51000 | 53000 | 36000 | 24000 | | |
| | 7-7 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 |
| PRESSURE | 1-1 | 4000 | 8000 | 15000 | 50000 | 90000 | 108000 | 124000 | 138000 | 150000 | 160000 | 168000 | 188000 |
| | 2-2 | 5000 | 72000 | 73000 | 90000 | 110000 | 124000 | 125000 | 126000 | 128000 | 140000 | | |
| | 6-1 | 18000 | 25000 | 33000 | 40000 | 48000 | 66000 | 117000 | 170000 | 206000 | 230000 | | |
| | 7-7 | 5000 | 10000 | 15000 | 20000 | 25000 | 30000 | 35000 | 40000 | 45000 | 50000 | 55000 | 60000 |
| WORK DURING .2" TRAVEL FT LBS | 1-1 | 33 | 100 | 166 | 416 | 1233 | 1633 | 1950 | 2200 | 2416 | 2593 | 2737 | 2922 |
| | 2-2 | 41 | 582 | 1200 | 1300 | 1666 | 2000 | 2066 | 2100 | 2116 | 1029 | | |
| | 6-1 | 200 | 366 | 483 | 600 | 733 | 900 | 1433 | 2400 | 3133 | 3552 | | |
| | 77 | 41 | 124 | 207 | 291 | 374 | 457 | 541 | 624 | 707 | 790 | 874 | 957 |
| WORK FT LBS. | 1-1 | 33 | 133 | 299 | 715 | 1948 | 3581 | 5531 | 7731 | 10147 | 12740 | 15477 | 18399 |
| | 2-2 | 41 | 623 | 1823 | 3123 | 4789 | 6789 | 8855 | 10955 | 13071 | 14100 | | |
| | 6-1 | 200 | 566 | 1049 | 1649 | 2382 | 3282 | 4715 | 7115 | 10248 | 13800 | | |
| | 7-7 | 41 | 165 | 372 | 663 | 1037 | 1494 | 2035 | 2659 | 3366 | 4156 | 5030 | 5987 |

FIG. 2

22. All four gears, it will be noticed, start without any pressure. In actual practice, with the gears in place between the yokes, a small initial pressure of several thousand pounds should be provided for, to take up any slack which may take place in the future and to compensate for irregularities in the other surrounding car details.

23. By examining the top row of Fig. 2, great fluctuations are being found in the increase of pressure for equal travels of two-tenths of an inch each; besides that, these irregularities take place at entirely different points of the stroke. For instance, gear 2—2 takes a sudden jump of 67,000 lbs. in closing from .2 inch to .4 inch. This means that all motion will abruptly stop until 72,000 lbs. has been reached. Gear 1—1 has a similar sudden increase a little later, while gear 6—1 increases its pressure rapidly in the latter part of the stroke.

24. Such fluctuations mean an uneven transmission of the energy to the car; in fact, it means a small shock preceding the final shock instead of a continuously and uniformly increasing force. If the laws of dynamics are applied to this case, and I do not see why they should not be, we certainly should try to overcome such fluctuations, which would give us practically a straight compression line.

25. The time did not permit else the writer would have tried a few experiments by pushing an engine against a car equipped at different times with different draft gears, but so, that the engine is stopped before the gear becomes solid, and by having a self-recording indicator to measure the impulse on the car, quite a marked difference could undoubtedly be found. A pendulum, or a heavy body, sliding on a pane of glass might be used for such a purpose.

26. Another reason for a straight compression line lies in the advantage of a high closing pressure. The final blow is mostly very great, not seldom exceeding 600,000 lbs. Therefore, the higher the closing pressure, the smaller will be the sudden jump, when the gear becomes solid. Not long ago I asked a car foreman, who is very well versed in these matters, what this closing pressure should be. "As high as possible" was the answer. The second diagram of Fig. 3 shows this principle. The work done by the gear is the same as in case 1—1, but the closing pressure is much higher.

27. The M. C. B. Coupler Committee for the coming year is looking into this question now and will undoubtedly make the proper recommendations after a thorough investigation.

28. By actual tests made by the L. S. & M. S. Ry. in 1902, it was found that an engine in coupling exerted from 65,000 to 142,000 lbs. The tensile forces for skilled, ordinary and rough handling of trains were found to be 50,000, 80,000 and 100,000 lbs. respectively; the buffing forces 80,000, 150,000 and 200,000 to 300,000 lbs.; 30 loaded cars running into 10 loaded cars at 6½ miles per hour registered a final blow of 346,492 lbs.

29. Care should be taken that an easy motion at the beginning of the stroke is secured. This is necessary to absorb the small oscillations and lurching, constantly taking place during transit, which will rack the car eventually if ignored.

30. The closing pressure of these gears varies possibly more than anything else, being from 60,000 to 230,000 lbs. In spring gears, we are very much limited in this respect, although besides twin and tandem springs, triple and quadruple springs have been used.

31. The higher the closing pressure, the larger will be the energy transformed during closing, which is of course of great importance in reducing the final blow.

32. The length of stroke is the other factor in this task; the longer it is the more effective the gear, but unless the method of carrying the coupler is improved, it would not be practicable to go beyond the present standard.

33. The element "Time" sometimes mentioned in this connection is identical with the length of the stroke, and if you have a gear, which transmits a certain amount of energy in a period twice as long as another gear, then its stroke must be practically twice as great also.

34. The recoil in our four cases is represented by the returning line near the bottom. As a rule, it decreases very uniformly. It should be small, so as to reduce the back lashing after the blow has been delivered. None the less, the greatest care must be taken that this recoil is sufficient to open the gear under any and all conditions, else you might just as well have a solid block in place of a draft gear.

35. Now, coming back to our 100,000 lbs. car, loaded and running at 8 miles per hour into another car of equal load, but standing still, the result would be as follows, provided the cars were equipped successively with the four gears in question.

36. Half of the energy of the moving car, of course, is transmitted to the standing car, and in doing so each of the meeting gears and car ends perform half of this work, hence:

| | Gear 1—1 | Gear 2—2 | Gear 6—1 | Gear 7—7 |
|---|---|---|---|---|
| Total energy transmitted per car in ft. lbs............. | 79,536 | 79,536 | 79,536 | 79,536 |
| Energy transformed by 1 draft gear in ft. lbs............ | 18,399 | 14,100 | 13,800 | 5,987 |
| Energy left for car to take direct, ft. lbs............... | 61,137 | 65,436 | 65,736 | 73,549 |

| | | | | |
|---|---|---|---|---|
| Percentage of energy transformed by 1 gear, ft. lbs. . | 23.2 | 17.6 | 17.3 | 7.5 |
| Recoil in ft. lbs. . . . . . . . . . . . . | 1,733 | 2,200 | 2,400 | 5,987 |
| Difference between energy transformed and recoil, ft. lbs. . . . . . . . . . . . . . . . . . . . . | 16,666 | 11,900 | 11,400 | 0 |
| Percentage of elasticity of gear. . . . . . . . . . . . . . . . . . . . . | 9.4 | 15.6 | 17.4 | 100 |

The diagram shows the elasticity of gear 7—7 less than 100 per cent. This, however, is due to the attachments yielding.

37. This shows that even at this slow speed, and even under the assumption that both of the meeting gears are alike, most of the blow is taken by the car directly.

38. Fig. 3 shows the same information in form of diagrams. Each one also shows the final pressure of the blow, assuming that the yielding of the cars would be the same in all four cases.

39. At higher speeds, the percentage of the work done by the gear is still less, and if the car runs into a post, or other unyielding obstacle, indeed looks almost insignificant. The following figures will make this clear:

Car running into another car at a speed of

| | 8 Miles. | 12 Miles. | 16 Miles. | 20 Miles. |
|---|---|---|---|---|
| Gear 1—1. . . . . . . . . . . . | 23.2% | 10.3% | 5.8% | 3.7% |
| “ 2—2. . . . . . . . . . . . | 17.6% | 7.8% | 4.4% | 2.8% |
| “ 6—1. . . . . . . . . . . . | 17.3% | 7.7% | 4.3% | 2.7% |
| “ 7—7. . . . . . . . . . . . | 7.5% | 3.3% | 1.9% | 1.2% |

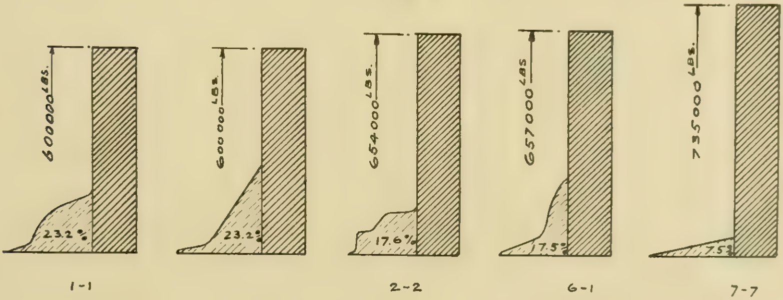


FIG. 3

Car running into an unyielding obstacle:

| | 8 Miles. | 12 Miles. | 16 Miles | 20 Miles. |
|---|---|---|---|---|
| Gear 1—1............ | 5.8% | 2.6% | 1.4% | .92% |
| " 2—2............ | 4.4% | 1.9% | 1.1% | .70% |
| " 6—1............ | 4.3% | 1.9% | 1.1% | .69% |
| " 7—7............ | 1.9% | 0.8% | 0.5% | .30% |

40. The question is often asked, "Does the results on the testing machine represent what takes place, if two cars strike each other at considerable speed?" For all practical purposes it does, inasmuch as the weight of the draft rigging is very small in comparison with that of the car, and if the weight of the gear could be reduced to zero, the two results would be exactly identical.

41. The drop test, on the contrary, does not represent actual conditions. Here the weight of the draft gear is very great compared with the striking weight (1640 lbs.), and even if you had a drop of 16,400 lbs., the dynamic effect would be entirely different from what you have on the car.

42. The collision test, now often spoken of, consists in dropping a car down an incline against a dynamometer. A great deal of information can undoubtedly be obtained by this course; however, great care must be exercised thereby, else the results will be misleading. For instance, our car with gear 1—1, striking as above, would transform 5.8 per cent. of the whole energy into a gradually increasing push on the car, and the remaining 94.2 per cent. is left for the car to take care of directly (assuming that the dynamometer does not yield).

43. If the car is stiff, the final blow or pressure registered, will be very high; but if the car is yielding, it will be comparatively low, even if equipped with a low capacity draft gear.

4. Likewise will the recoil of the car itself, the kick, depend on whether we have a solid or a springy frame construction. In fact, it will depend on this item very much more than on the type of the draft gear.

## *Principle of the Different Gears.*

The next step is to look into the different methods or principles underlying the different gears.

45. Not mentioning the somewhat ancient rubber cushions and disregarding the volute springs, which are so much used in Europe, the ordinary helical spring forms the basis of nearly every gear in existence.

46. The plain spring gears are arranged as twin, tandem, triples, or sometimes quadruple springs. The last two have also been arranged so as to have more resistance in compression than in tension. Of late heavier springs, the M. C. B. class G with a closing pressure of 30,000 lbs. each are often used.

47. Most of the friction draft gears can be classified into two large groups. The first group, or Class P, as we will hereafter call it (P was chosen to indicate Parallel friction surfaces), gets its high resistance principally by pressing laterally on two or more friction pieces, which in moving in and out are rubbing against parallel surfaces, thus causing friction and retardation in whatever direction the gear happens to move. Diagram P, 1, Fig. 4, explains this fundamental principle.

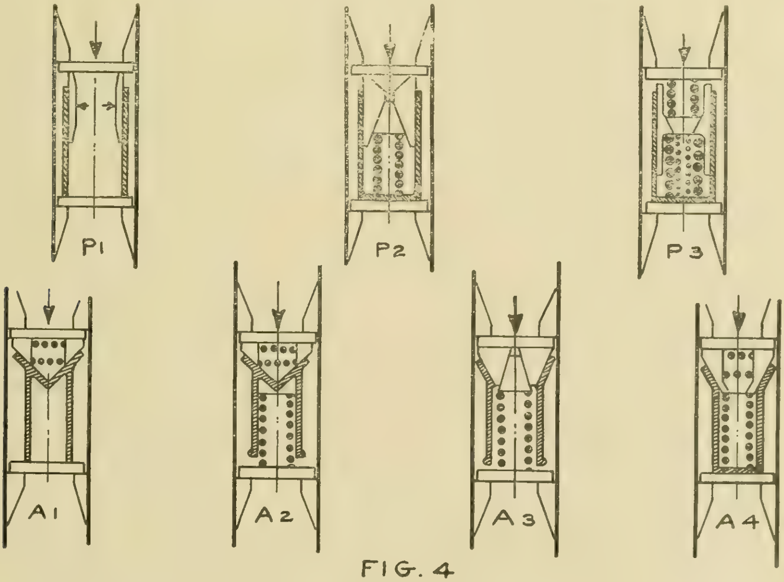


FIG. 4

48. One peculiarity, or rather drawback, to this arrangement is the fact that it takes a great deal of pressure to produce sufficient friction for retarding the motion, and to over-

come this, various means are being used. The friction pieces can be made in form of flat plates which are sandwiched between each other so that you multiply the friction for every pair of plates; in other words, you have the same effect as if you would insert separately a number of leaves into a book, then close it and try to pull them out.

49. This same arrangement is often attempted by arranging the plates in a circle, such as split pipes.

50. Of course, all these arrangements suffer under the fact that the final resistance changes in direct proportion to the coefficient of friction. If you get oil on the surfaces and reduce the friction to, say, one-half, a gear originally closing at 200,000 lbs. will now close at 100,000 lbs.

51. The same may be said if the bearing surfaces get polished by the service, while corrosion works as effectively in the other direction and may cause the gear to stick.

52. To overcome this feature as much as possible the friction surfaces are sometimes machined.

53. The lateral pressure is sometimes obtained by one follower plate acting on cams, which have a tendency to spread the friction pieces.

54. Sometimes a similar effect is obtained by placing the draft spring in a diagonal position. It is interesting to note that in a draft gear of this class a lateral spring cannot be employed, inasmuch as there would be no possibility of increasing and decreasing the pressure as the gear may close or open.

55. In most cases a cone, or wedge, is employed to spread the friction pieces, which is illustrated in diagram P, 2. It is self-evident that the gear in closing compresses the spring gradually and proportionately increases the lateral pressure of the friction pieces by the angle of the spreader. The steeper this angle the greater the pressure.

56. The only trouble is that beyond a certain limit the spreader will not relieve itself and the gear will stick. The writer knows of several cases where gears were tried on the testing machine and after being compressed once simply remained solid.

57. Even in actual service there is considerable trouble experienced on this line. In repairing such gears great care should be taken that inexperienced laborers do not get hurt by unexpected "openings."

58. One remedy against "sticking" is to use anti-friction rollers between the spreaders and the friction pieces, and another is to use a separate spring. (See diagram P, 3.) This spring may be located on the outside or the inside of the friction casing.

59. Even such a release spring is not always able to prevent sticking, and to help matters along the friction surfaces may be machined to a very slight taper longitudinally. Sometimes they are also made of different lengths so as to assist the release spring in starting them backward.

60. Here we come to the second class of friction gears, as illustrated by the diagrams A. (A stands for Angular friction surfaces.) As will be seen by diagram A 1, the blow is acting on friction pieces whose motion is not only resisted by the friction on the gliding surfaces, but also by the angularity of the same; the blunter the angle the greater the resistance.

61. The spreading of the friction pieces is very often accomplished by the use of springs. Of course, any yieldable device may be used, but it will be noticed that the lateral motion is always quite considerable, which in the Class P gears is never the case.

62. As said before, the blunter the angle the greater the resistance. This has its advantages and also its disadvantages. While it increases the closing pressure of the gear, it also causes an abrupt and stiff motion in the beginning of the stroke. This is objectionable and it has sometimes been overcome by using two sets of friction pieces in tandem, provided with different angles, so that one set would assist in getting an easy motion in the beginning of the stroke, while the other would insure a high resistance later on.

63. This is very important, as there are even now lots of cases where the draft gear does not protect the car against the small vibrations and oscillations constantly occurring during

transit, and although these oscillations will not break a car they will eventually rack it.

64. Another way to get an easy starting motion is to use a preliminary spring as shown in diagram A 2. Its function is to compress under a light load and in advance of the friction pieces.

65. Even in diagram P 3 there was such a preliminary spring. In that particular case, however, it acted also as spreader spring. Here, owing to the fact that the friction pieces do not move until this spring has partly, or fully been compressed, there is a sudden increase in the resistance at that point, and after this spring becomes solid the resistance does not increase any more than what little the compression of the release spring may add.

66. Coming back to Class A again, another method of spreading the friction pieces is shown in diagram A 3. Here a cone or wedge is used, which is made yieldable by a spring. The angles in this case must be carefully watched or else the beginning of the stroke will be much more abrupt than even case A 1. To offset this, the cylinder has been shown cut short so that the spreader spring can also act as preliminary spring.

67. On the other hand, if the angles are reduced too much the danger exists of the friction pieces locking so tight that the spring will not be able to release the grip. This is especially true since the spring has no cylinder bottom to rest on and since we have just twice the number of friction surfaces.

68. If we decrease the angle in A 1 below a certain line so as to get an easier motion and a greater longitudinal travel, we will find that the friction pieces will not release any more under the action of the spreading spring and a release spring must be used. An arrangement of this sort is shown in diagram A 4. Fortunately the angle can now be made as steep as desired and an easy motion is secured from beginning by the friction pieces without the use of preliminary springs.

69. There is a third class of friction draft gears which may be called *friction spring gears* for the reason that the gear really consists of coil springs which are merely dampened or stiffened by frictional contacts so as to have a high resistance in closing and not over the original capacity when opening.

70. Different constructions are followed in this direction but, whatever it may be, one of the springs will have to be made out of round or none concentric, else it could not yield laterally. The bearing surfaces in thes cases are sometimes very small, consisting of mere lines instead of broad surfaces. To overcome this objection the bars are sometimes made of square or other similar sections, which make it possible to have flat bearing surfaces.

71. Another way is to use a volute spring with conical sides which, in closing, will slide on the adjoining turns, thereby causing friction. In this case, the whole gear conists of one single spring. All friction spring gears, as a rule, are light in weight.

72. Under the fourth class of friction draft gears we may place all those which in course of compression compell some parts to rotate and, by so doing, engage in frictional contact with other parts not rotating. For convenience sake, we may call them *Torsion Gears.*

73. Other gears use leaf springs and in so doing make use of the friction between each individual leaf, which you find in any other leaf spring, and gears based on the principal of such a spring may be called *Leaf Spring Gears.*

### *Repairs to Draft Gears.*

74. On steel cars, which, as known, are of a comparatively recent build and which are usually equipped with a friction, or improved spring gear, the repairs on draft gears is not so excessive, but on the wooden equipment, as stated in the beginning of this paper, fully 75 per cent of all the cars shopped have to undergo repairs on the draft gears.

75. It is true, often repairs are charged to the draft gears which are made on the attachments, such as yokes, followers, draft lugs, etc., for which the gear is often not at all responsible, and the same can be said of the draft sills themselves.

76. To reduce these repairs as much as possible, it is absolutely necessary to design on proper principles, and to make gear and attachment strong enough to meet the severe conditions always surrounding them.

### *Attachments.*

77. Some manufacturers deserve a good deal of credit for trying to improve the attachments, realizing undoubtedly that all the shocks, before and after the gears are closed, will pass through them. Some unite the front and back lugs into one, thereby not only strengthening the fastening but also stiffening the draft sills in themselves.

78. Others try to do away with the draft lugs and follower plates, using keys instead; in fact, they extend the use of keys for fastening the yoke to the coupler, thus doing away with the two coupler rivets.

79. There is no doubt that these rivets are fully adequate in most cases. However, under compression in tandem gears, stresses may come upon them which are unsafe.

80. Of late sufficient lateral motion for the coupler is considered absolutely necessary to relieve the cars of lateral strains on curves. (Some tests by the C. & N. W. and other railroads found these even to exceed 50,000 lbs. at the carry iron.) This means relieving the car frame, protecting the coupler and knuckle from being pried and broken, means fewer derailments, less end wear in the brasses, and less flange wear on the wheels.

81. The latter follows from the fact that through experiments (L. S. & M. S. R. R. and others), it was found that an engine can pull more cars, if they are equipped with lateral motion at the coupler.

82. As to what clearance should be allowed per side is still an open question; undoubtedly, the more the better, since a device for bringing the coupler back into central position should be used anyhow as soon as we exceed about 1 inch per side.

83. Of the different centering devices now used, the simplest is undoubtedly the best. No delicate arrangement will be found to stand the service at this place.

84. By allowing such lateral movement, we introduce new conditions for the coupler rivets which, in the present form, they cannot meet. For this reason a better fastening between yoke and coupler is bound to follow.

85. The attachment should, by all means, be arranged to

permit the proper inspection of the gear in the shop as well as on the road. The writer was forcibly impressed with this the other day when he heard a repair foreman denounce a certain gear as "the worst one on the road because it cannot be inspected properly."

86. Unfortunately, a continuous bottom follower guide is almost imperative to stiffen the draft sills, and this very guide makes inspection quite a task. Twin springs, however, are not as bad in this respect as longer draft gears.

87. But twin spring gears have a comparatively long space left between the rear follower plate and the body bolster, and this has always proven to be a weak spot, unless a substantial bottom cover plate is made to extend the whole length. I know of a case where many thousand dollars were spent in changing a draft gear on a lot of cars because they showed a weakness at this very place.

88. Any shop record would disclose that the largest proportion of repairs is done on draft sills equipped with short draft gears. Tandem springs are far superior in this respect and the friction gears as a rule are nearly as long.

### *Construction of Gears.*

89. To describe the multitude of draft gears in their construction would be almost impossible inasmuch as there must be several thousand designs patented, and possibly not less than a hundred in actual use. Suffice it then to touch on some of the most important points which should be watched in the construction of the details.

90. First of all let us remember that simplicity is one of the most important principles in car construction, and this indeed applies to a draft gear with equal force. If we had to choose between two gears, one consisting of say 5, the other of 20 pieces, everything else being equal, there should be no question as to choice.

91. Looking at it from the storekeeper's and stock clerk's standpoint, a small number of pieces suggest itself with equal force. It is true that some gears are furnished assembled and complete, which leaves the storekeeper in good shape. But in repairing such a gear you will either have to take it apart or

else pay for a whole new gear every time one of the parts gets worn or broken.

92. The bearing surfaces should be large so as to minimize wear. If this is done, a gear should last a long time. One time the writer had a gear in constant motion for about five (5) days and nights, a bull dozer closing it with every stroke. After this period there could be noticed hardly any wear other than the bearing surfaces were well smoothed off.

93. To avoid unequal wear and consequent changes of the contour in the bearing surfaces, the latter, if at all possible, should be kept flat and well braced so as to get equal pressure all over. This is observed in most of the gears, but with the cam and lever arrangements the conditions are such that flat friction surfaces are out of question.

94. The design should be of such a nature that machining of the different parts is unnecessary. This costs money, and is apt to raise the price of a gear unnecessarily high. Such machining is also an indication that a delicate adjustment is essential.

95. The most reliable device for this purpose is undoubtedly the one which can be made in the foundry and the shops like any other part of the car and which will work in spite of everything being rough and conditions far from what they really should be.

96. Some gears require great accuracy on locating the draft lugs and other attachments, special gauges being necessary, while other gears will work just as promptly if this work is executed in accordance with ordinary shop practice.

97. When the gear closes, all yielding and minor parts should be out of action and the blow should be transmitted through solid castings to the car just the same as if there were no draft gear present. A failure to comply with this is often fatal. I know of a case where a large lot of cars gave no end of trouble on this account and the gears were removed as fast as the cars were shopped.

98. Such experiments are costly to the railroads. They show how important it is to make the mechanical details right and how unsafe it would be to judge the gear simply by its "card"; the card may be all right and the gear may be worthless.

99. Again, the card may be taken by unqualified parties and errors may thus occur. I know of a case where a card showed 1/4 friction resisted motion while, in reality, the gear had 15-16. This shows again how dangerous it would be to judge a gear by its card alone.

100. Special material should not be resorted to in designing such an important detail, if it can at all be avoided. For instance, a spring strained so high that ordinary open hearth steel will not answer should not be used. In the first place, it costs more money, and in the second place, the chances for a "slip" in the quality are greater.

101. Neither should it be necessary to grind the springs, and if they can be chosen from the M. C. B. standard designs that much better, because it would simplify matters a great deal in carrying stock material.

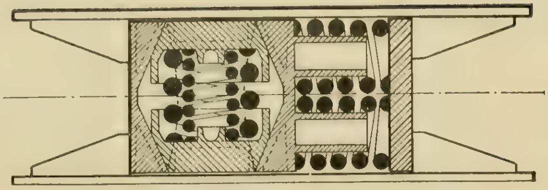
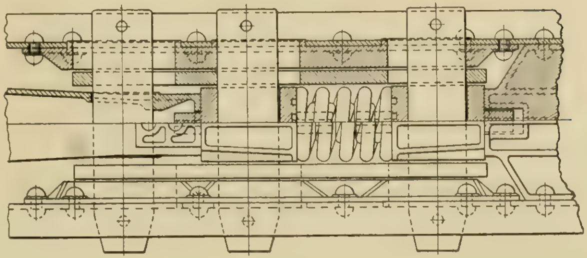
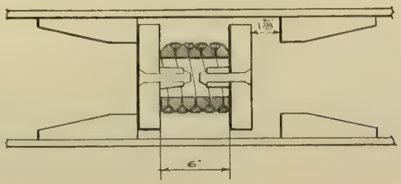
102. Special machinery often reduces the cost of production tremendously, but if you can get good gears made of a few ordinary castings and ordinary springs, do not go to refinements.

103. The whole question resolves itself into getting as much protection for the car, as much strength and durability in the draft gear, as little repair and as small a first cost, as possible.

104. The railroads and manufacturers both realize that they are working on the same problem and that they have to help each other in this task, and undoubtedly it is due to this harmony that such gratifying results have been accomplished already.

105. Following will be found a series of cuts showing some draft gears used to-day. The list, however, is not complete by any means, and if you do not find a certain gear, it does not mean that it has nat been used.

These cuts were received directly from the respective manufacturers upon my request, and the promptness and the whole-souled manner in which every one responded again proves what I said in the beginning of this paper, that every one is working in a broad-spirited way for that one and common goal, a good draft gear.

| | MAKE. | REMARKS. |
|---|---|---|
|  | Piper, | Angular Friction Surfaces. |
|  | Farlow, | Keys and Links instead of Yoke. |
|  | Harvey, | Friction Spring Gear. |

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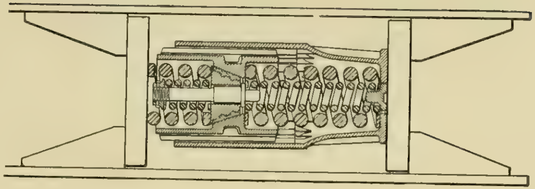
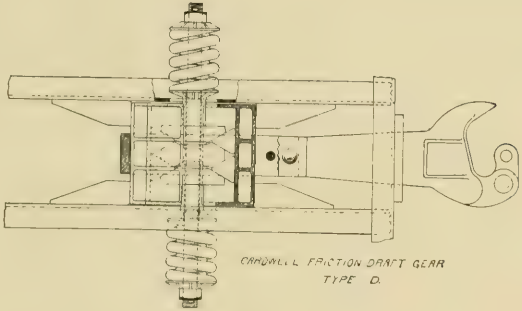
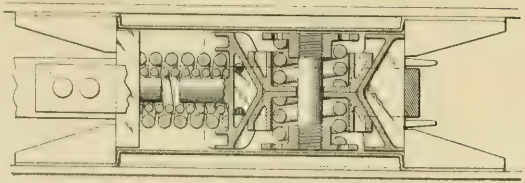
|  | Westinghouse, | Parallel Friction Surfaces. |
|  | Cardwell, | Angular Friction Surfaces. |
|  | Republic, | Angular Friction Surfaces, |

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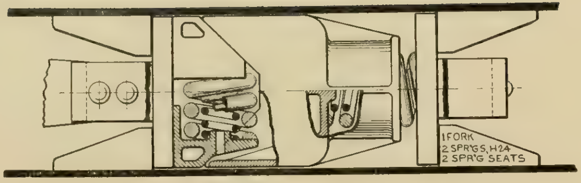
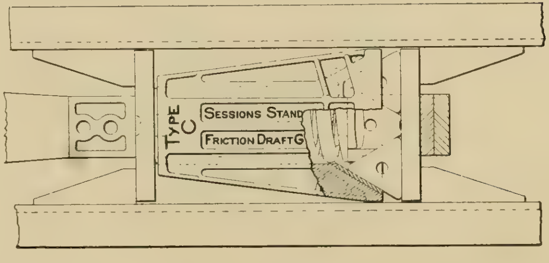
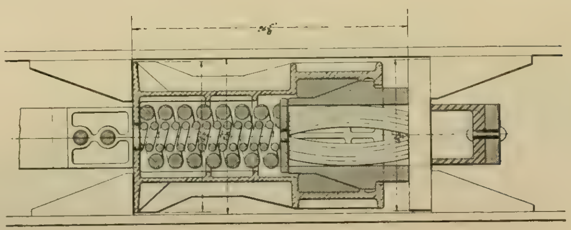
|  | Climax, | Angular Friction Surfaces. |
|  | Session, | Angular Friction Surfaces. |
|  | Gould, | Angular Friction Surfaces. |

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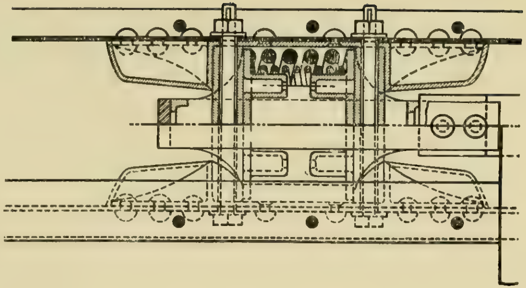
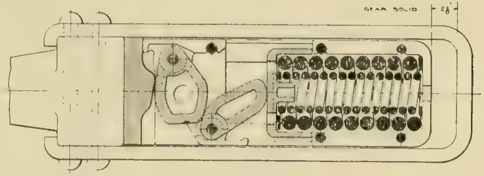
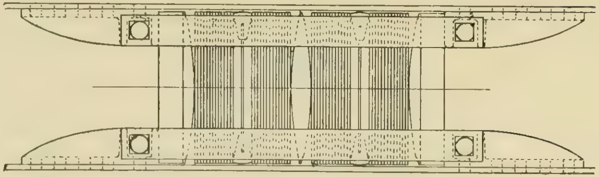
|  | Dayton, | Spring Gear. |
|  | McCord, | Lever Arrangement. |
|  | Waugh, | Leaf Spring Gear. |

PRESIDENT: Mr. Stucki has certainly given us a lot to think about. We have with us to-night Mr. Reese, who represents the Westinghouse Friction Draft Gear, and I am going to ask him to open the discussion.

MR. F. T. REESE: Mr. President and Gentlemen—It is not my desire to criticise Mr. Stucki's paper, for the reason that the ideas as set forth, in a general way, agree with mine. However, I wish to add, or rather to go into certain subjects touched on in more detail, in order that you may possibly gain further knowledge of the beneficial results obtained by use of frictional surfaces as a means of absorbing shock.

I believe the idea of employing friction in a draft gear as a means of absorbing shock originated with Mr. George Westinghouse, and the necessity of more ample means of resisting the shock with the absence of the detrimental effect of recoil was demonstrated early during the air brake tests on the Burlington Road.

As you already know, the automatic air brake apparatus was not at that time perfected to the degree which it is now, which contributed in a way to bringing out very forcibly the inadequacy of the draft gear with which the cars were equipped at that time. In order to increase the capacity of this spring gear larger springs were added, which allied the buffing shocks in a greater degree, but the trouble experienced through the effects of the increased recoil of these springs was greater than the benefits derived from the increased resistance to buffing shocks. The necessity of employing some means of high capacity of absorbtion without the detrimental effect of recoil was very apparent, and as a consequence friction was resorted to as a means of accomplishing this end, whereby the shock incident to the buffing and pulling strains would be dissipated. We will admit that a spring up to its capacity gives practically a uniform resistance, or in other words, a uniform means of absorbing shock. In the form of a spring we have an incremental resistance, or the resistance of the spring increases proportionately to its travel, but by using this means of absorbing the blow we have the element of recoil, as the energy of the blow has not been dissipated and is returned in a large measure through the recoil of the spring. Considering the strength of the parts which we now have in use for fastening our equipment together, were we to employ springs of equal capacity to that which we obtain by the use of the frictional element in the draft gear, the resultant detrimental effects of the recoil would exclude their use.

Referring to the diagram which we get from a friction draft gear it is in a measure the reverse of a steam engine indicator diagram. We have our line of steam admission which corresponds to the line of resistance shown on the draft gear indicator card, the line of release and the line of compression, but as I said before, exactly the reverse of the steam indicator card.

However, I believe you will all agree with me that the ideal line of resistance as a means of absorbing shock would be one that would indicate a uniformly increasing resistance throughout the total travel of the draft gear. This line in itself does not indicate the value of the draft gear without taking into consideration another element of the card, which line gives the amount of energy dissipated; this is what can be termed the release line, and the nearer to zero this line comes the more efficient is the apparatus, and subtracting from the total amount of the absorbed energy the returned energy, represented by the force of the recoil, we have the dissipated energy, and hence the value of the draft gear. In other words, if you had a spring of 180,000 pounds capacity you would have approximately the same amount of energy returned, but by employing friction there is but very little energy of the blow returned through the apparatus, thus an absence of recoil and a dissipation of a large percentage of the blow which is received by the apparatus before it reaches the car body.

There is another question which I notice Mr. Stucki has brought out in his paper—that is his reference to the force of the blows that are received by cars in service. I may say that we have carried on a great many experiments along these lines and we have found that there are very few blows transmitted to a car in buffing that are under 100,000 pounds, and in pulling, where we feel that the absence of recoil is as essential as in buffing, almost all of these are under 180,000 pounds. We have a dynamometer car which will register about 600,000 pounds, that means pounds pressure, and many times we have found that the dynamometer has reached its capacity, which would probably be reached in ordinary service at a speed of about eight miles per hour, and for this reason we know that most of the buffing blows are very much higher than the pulling strain. The majority of these latter strains, we believe, are almost all within the capacity of 180,000 pounds. Considering the pulling strain, there is one thing which I believe is a very essential element in any draft gear, and that is to provide for a preliminary spring movement which will take up all the small shocks and vibrations incident to the movement of a train of cars after they are under way. The capacity of this spring in its total working movement before the frictional device comes into use should be about 15,000 pounds, and by the employment of this spring we save in a large measure the continual movement of the frictional parts. For example, take a train of 40 cars, hauled by a locomotive having a tractive power of 20,000 pounds. Should the locomotive exert its full tractive effort on the forward part of the train, at the twentieth car from the forward end, assuming all cars to be of equal weight and lading, the pull on this car would be equal to one-half of the amount of pull necessary at the forward end of the train and would therefore be within the limit of the capacity of the preliminary spring, and this would protect the frictional parts by reducing the number of movements of the same, and for this reason we believe this preliminary spring is a valuable factor in any friction draft gear.

It has been brought to my attention a number of times that we, who are manufacturers of friction draft gear, have had a good many failures of the gear when placed on locomotive tenders. We concede this, but we believe that the results obtained from the use of a friction draft gear on a locomotive tender is far in advance of that which may be had by the use of any spring gears. However, there is one thing which is commonly lost sight of and not taken into consideration when comparing the results of the use of friction draft gear in tender service: there is presumably 100 movements in tender service to one movement received in car service, and in addition to this only one draft gear to take care of the shocks, the front end of the tender being rigidly coupled to the locomotive, whereas in car service you have a gear at both ends of the car, and they are usually in service simultaneously. The present arrangement on tenders, of course, throws the shock incident to this service entirely on one draft gear. Some time ago when I was in the locomotive business I tried to get some railroad men to put a draft gear between the tender and the engine, but which I was never able to accomplish. Whether it has been done as yet I do not know, but I think it is just as essential there as in any other part of the train.

PRESIDENT: It would be interesting to know the experience of practical men present regarding paragraphs 56 and 57 in which he speaks of the draft gear being forced back and sticking so that the recoil of the spring does not bring it back to normal position . We have had several cases of that kind, and I remember one in particular where the draft gear had been taken out and was lying on the ground and the workman gave it a sharp blow with the hammer and the pieces flew out with such force that one of them struck him in the face and he was quite seriously injured.

We have some other draft gear men with us. Mr. Harvey, we would be glad to hear from you.

MR. GEORGE L. HARVEY: Mr. President and Gentlemen—I was very much interested in Mr. Stucki's paper and there are a few points in it that I think might be touched upon.

In testing any new draft gear I think it should be rusted with acid or salt to get it into the condition it will be in service. A new gear especially, if covered with paint or scale, will not give the same results as it will in practice. The parts become rusted thoroughly and run in a cloud of dust and dirt.

Next: The ordinary tests generally made are static tests. They run the tests up to 180,000 pounds, or the closing point of the gear only, but in service they are subjected to very much higher loads, 500,000 and 600,000 pounds. It is suggested that the horn of the coupler will take off some of this blow, but it should be remembered that deadwoods and end sills are often knocked in. You will find that on many gears the strain comes entirely on the gears, and I think the suggestion of the M. C. B. Association last year to have tests up to 500,000 pounds would be very much more valuable than the low tests now made which I do not believe give much idea of actual service loads. I think laboratory tests can be made to give idea of service tests on gears. Nevertheless, I do not think they are the best tests.

Gears never close squarely. In a static machine they are closed so that you can measure to the 1-10,000th of an inch, but in service the back end of the coupler is not square by any means. Furthermore, if one of the stops is driven back out of place you can see that the gear is closed eccentrically. To imitate this eccentric load in a static machine you can put a plate under the gear and test it on the bevel plate, beveled 3/8″ to the foot; then turn it say 90 degrees and test over again, and so on in four directions. Some gears will take such a test in one direction and not in another. Then the gears should be reversed endwise to test the other end of the gear again for eccentric loading. I do not know that this method of testing has been suggested for tests, but it seems to me that it should be done by all means. Such laboratory tests should come somewhere near service tests.

The drop test has been criticised more or less. It is not a fair test. I believe it is fairer than the static test, however. The static testing machine as ordinarily used requires ten to fifteen minutes to close and release the spring and take the reading. There are machines which will test one of these devices and close it in two or three seconds and make a card, and I believe that such a machine gives a better test than the slow machine. The pile driver tests are, I believe, closer to the service test than the static tests. But the way the M. C. B. drop hammer is arranged it is hardly a fair test. They have placed under the anvil of the hammer of the pile driver a number of springs; these springs have only 2″ travel and they are like the twin gears in action, and not in tandem as they are in a train. You hit a car in a train and it starts to move, and it moves the next one back and all the springs in the train are in use. That is evidently not the effect you get from the springs under the anvil of the drop hammer. The tests on the drop hammer at Purdue have very rarely been on any gear where they have allowed the horn to come against the end sill. They have always thrown the entire strain on the gear. Cars are not sent out that way these days. Part of the strain does go on the end sill. And there are very few attachments for any gear which will stand a very heavy drop of the hammer, unless the horn of the coupler does strike.

The gear itself should be strong enough, however, so that you can run a pile driver as high as you please without injuring the gear itself.

The weight of the gear is an important item. Take gears that vary as much as 400 pounds, for instance. A car that moves 30 miles a day on an average and call the cost of transportation per ton per mile four mills, which is a fair figure, and you will find that the 400 pounds excess will cost $8.60 a year to move. When you consider the number of cars in use on the different roads, you can imagine the enormous figures this extra dead weight runs into. Some railroad men figure that they not only save that amount, but that they can carry 400 pounds more freight on a car than when equipped with the heavier device. Of course, that is true of all the various parts of a car. The enormous increase in the last fifteen years in the dead loads of cars is a very serious item, and I do not believe engineers can be any too careful in designing cars to keep the dead weight down as low as possible.

Some engineers prefer to equip the locomotive entirely with friction draft gears, and think that the engine receives the greatest amount of strain, and if you take care of that part of the train the rest can take care of itself. I have seen a great many tests, on both loaded and empty trains running from 36 to 54 cars at a speed of from 4 to 25 miles an hour. In these tests there was one breakage in those trains at the ninth car from the engine, another on the twelfth, and on another one where it was the third car from the rear end of the train, and all the rest were near the middle of the train. There was not a single instance in all those trains of breaking at the engine. I have heard of a number of sticky valves since these C. B. & Q. tests.

Durability: In friction gears the friction is not dependent so much on the area of the surface of contact, but the life of the gear is, the larger the area and the harder the material the longer the service.

The first cost, of course, should be low.

The device should meet with the existing M. C. B. standards. I suppose 90 per cent of the cars in the United States are equipped with devices which meet in every particular the M. C.

B. standards, and it seems to me that before any radical changes are made and money expended in building over these cars, that question should be seriously considered.

The gear should be easily inspected. Men haven't much time to give to that purpose and every part should be so arranged that it can be seen readily.

As to the compression line, I do not believe you can lay out one that could be followed by any manufacturer of gears. In the static machines you get one line in compression, and if the gear is closed more rapidly you will get another line, and the faster and faster you operate the machine new lines will show with the same gear. Still you cannot say that gear is of no value because it does not follow a particular line. I think the best line of compression is one where you save the greatest amount of draw bars and yokes and knuckles and couplers. If you equip old cars on which you have a repair record of those parts, with a new device, and then keep a record you could have relative values on the same car under exactly the same conditions. It has been found that the old 1x4 yoke and the 1½"x6" followers are strong enough to carry a friction gear. I notice the M. C. B. has increased these sizes. I do not think you will have any trouble from that source. I believe they are now large enough to meet all requirements.

I think the most expensive spring gear is the old 6¼x8 spring which carries about 20,000 pounds and costs 90 cents. I thank you.

PRESIDENT: Right in between these engineers we would like to hear from some of the men who have met, not theory, but conditions. Mr. Stark, will you tell us of your experience?

MR. F. H. STARK: Mr. President, I feel a little out of place in discussing this subject. We have so many technically trained men here. There is a great deal that might be said, but I believe that the paper presented this evening is without doubt the most valuable contribution to railroad literature on this subject. The author has covered the ground in a most plain, thorough and practical manner.

I will frankly confess that my first impression was that a friction device depended on its simplicity and strength of parts. Mr. Stucki has pointed out the cardinal principles essential to the successful frictional device. In the first place he has referred to the various methods employed in order to give an easy action to the first ½″ of travel, and then the gradual increase. The character of the material should be considered so as to produce a uniform wear. The area of bearing surface is also important. As has been stated, the ordinary helical spring gives about the best action as far as it goes, and by introducing such a preliminary spring as most of the draft gears have, it looks as if that is the most practical.

In the latter part of Section 7 the author has emphasized the importance of uniform construction regardless of the carrying capacity of the car. To that should be added, I think, the center longitudinal members, commonly called center sills, the backbone of the draft gear.

As expressed in Section 11, the train and yard men have grown careless and expect the modern car to be indestructible. The operating officials are a party to this erroneous idea. Ten years ago the more minor damage to a car required an explanation from the crew; today it is considered faulty construction and poor material. Eminent engineers have honestly endeavored by theory and service experience to distribute the material so as to make each part 100 per cent strong. Failing in this we have turned to some sort of a friction device. I believe that the operating officials will realize some day, as some railroads are even now beginning to, that cars should be treated with more consideration. The failure of a coupler or any of the constituent parts does not represent the damage to the car. Everything has to have its beginning, and that initial fracture or start through the failure of one small detail results later on in extensive repairs. Mr. Reese refers to the locomotive service as being the most severe. A locomotive is in service more hours per day, but I don't believe the engine gets any such service as the average standard car does. Nobody thinks of running an engine into a number of cars at the rate of four miles an hour.

Time limit and length of stroke is a serious barrier. Back in 1895, when the subject of M. C. B. couplers was discussed in the Chicago Railway Club, I advocated a longer travel. I believe each half inch added will do more effective work than the first inch or so. There are some difficulties in the way. To increase the travel would perhaps cause in some cases the butt end of the coupler to come in contact with the carrier irons. However, I believe that it would be better to have 4" of travel if it could be accomplished without changing the length of coupler shank. And even after all this is resorted to, I believe we will have to come back to the more rational methods of handling cars. The P. R. R. has recently issued general and imperative orders, that cars must not be moved at a speed exceeding two miles an hour when coupling, and when in their yards at Altoona recently I was surprised at the careful manner in which they handled the cars. The usual practice in our switching and classification yards, either by poling or by the locomotive, is away behind the times as compared with the P. R. R. gravity yards and system of operation. From an operating and monetary standpoint the loss on account of damage to draft attachments and the constituent parts is greater than any other phrase of the maitnenance of freight car equipment, and it is a very serious condition. If we could reduce the cost of maintenance of railroad cars 10 per cent, it would pay the interest on the investment for additional locomotives and the salaries of a great many more yard men. And I believe the time will come when the railroads will awaken to the situation and not spend so much money for increased dead weight with the added investment, but will handle the cars differently. I do not mean to say there is no merit in the friction draft gear, because if we will examine a lot of cars that are so equipped there is no question that we will find the drafts themselves and the many parts in better condition. And yet the device must not be given credit for all of that. Because first they are attached to later designs of cars that are more substantial. The sills are tied together in a better way. The forces are transmitted nearer to the body bolster, while in the old single or twin-spring arrangement it was concentrated at a point where it had but little protection. Consequently, any gear that will transmit the forces through the draft sills in a larger way and more directly through and beyond the body bolsters, has advantages.

My experience with friction devices is somewhat limited. I can readily see that with wedges designed to give an easy motion, the surfaces might corrode and the wedges stick. On the other hand, if the degree of angle is more pronounced to insure positive release, the resistance might be too abrupt.

The question arises, what would be the ideal line indicating the most practical resistance. As a suggestion, the first half-inch travel might run up to twenty thousand, and from that point a uniform increase up to three hundred thousand. The longer the travel the better, up to a reasonable limit.

PRESIDENT: We still have some representatives of different draft gears with us—and I may say that they are here by invitation—as well as some practical car men, and we would like to hear from as many as possible.

MR. M. A. GARRETT: Mr. President—Like Mr. Stark, I think this is one of the most able railroad papers I have ever heard read. Each section is a suggestive head by itself and we could talk all night on the different heads.

I would like to call attention particularly to one point on the subject. For instance, in Section 4 Mr. Stucki says: "But the methods, or rather the constructions are so numerous and differ so radically from each other, that we cannot help but think that lots of energy has been and possibly is yet being wasted in not starting in the right direction."

Now, I think that one of the faults in the procedure for solving this draft gear question is that we have not started in the right direction in the respect of not laying a foundation that is unfailing, just the same as this building is built on a foundation that is unfailing.

We may work out various cushions, either friction or spring, but we must first have a foundation that will positively resist any shock that can possibly be delivered in wrecks or fair or unfair usage.

The fact is, there is a great difference of opinion in regard to what kind of cushion it is best to use in draft gear, but I think we all agree that we must provide a foundation—that is, an attachment which is positively indestructible and will hold firmly and without yielding any cushion that we may wish to use. Of what use is a high-capacity cushion if we cannot hold it in its place against great service shocks?

I maintain that in most draft gear designs, as now used, an indestructible foundation has not been, nor can be provided, because the elements of the designs will not permit it. But to go fully into this feature of the question time will not permit tonight.

Another thing: This paper, because of its wide range, does not go into detail quite as far as might be. The great and vital desideratum to take note of is the effect a draft gear has on, and the protection it gives to, the car in service. We may theorize and test, but so long as we do not produce a draft gear that allows only the minimum damage to a car we are not making very great progress.

Therefore, I should like to make some suggestions as to what a good draft gear should afford. And in doing this I believe you will agree with me that I am in line with the railroad man's more or less unhappy experience with cars on the "Rip" track for draft gear failures. The suggestions are as follows:

No failure of coupler fastening like the shearing of rivets.
No crushing in of wooden end sills.
No crushing of draft timber ends.
No crushing of dead woods.
No spreading of draft timbers.
No splitting of center sills on low-hung cars.
No splitting of center sills from side thrusts on wooden draft timbers.
No breaking of coupler pin clevises and chains from too much forward coupler travel.
No break-in-two's from same cause.
No staving-in of metal end sills.
No distortion of metal draft arms.
No telescope action like gear being driven back toward transom, in whole or in part.

It should also afford a minimum of—

Face breakages of coupler.
Draft spring breakages.
Knuckle wear.
Wear on contour lines of coupler.
Journal brass end wear.
Coal pile "wear," caused by rigidity or draft gear and friction on curves.

Side thrusts on truck frame and car, account of rigid coupler with long pockets.

Axle collar wear.

Wheel flange wear.

Flange breakages from side thrusts.

Track wear.

It should also afford a minimum quantity of extras to be carried, such as—

Draft springs.

Cheek plates or lugs.

Follower plates.

Bar iron for coupler yokes.

Rivets for coupler yokes.

Angles or iron plates for dead woods.

Oak lumber for dead woods.

Oak lumber for end sills.

Oak lumber for draft timbers.

It should also be self-centering.

Replacement of breakages free of charge of parts furnished by manufacturers of draft gear should also be afforded, whether such breakages are result of wrecks or otherwise.

It should also afford protection by manufacturers against damages to draft gear caused by buffing shocks—that is manufacturers of draft gear should be required to pay for damages resulting as follows—

Wooden end sills stove in.

Metal end sills stove in.

Wooden draft arms wrecked on end from couplers striking them.

Wooden dead woods destroyed so as to require replacement.

Distortion of channel draft arms between transom bolster and end sill.

Failure of coupled fastening, whether riveted or otherwise.

These suggestions will undoubtedly be considered by some somewhat extreme and impossible of attainment. I can only say they are already attained.

PRESIDENT: I do not know just how many draft gears would be left if they threw out all that do not fulfill all the conditions laid down by Mr. Garrett.

MR. JULIUS KRAUSE: Just as the gentleman states, we ought to have a foundation for the draft gear; weak center sills, coupler stops and follower plates will not answer, but the majority of the steel cars where draft gears have been applied have the above parts strong enough to stand the service, providing the draft gear is properly designed. It was my pleasure to travel with the first fifty steel cars equipped with the Westinghouse Friction Draft Gear. I was a little doubtful about the claims for it, and was anxious to see the horn of the coupler strike the end sill. I remember while at South Fork, I had two, Class H-6 engines, with a draw-bar pull of 80,000 pounds coupled to fifty of these cars and applied the brakes on the rear end; had the two engines use sand and attempt to back train, which they were unable to accomplish, but the horn of coupler on car next to the engine, still showed 1¼ inches between horn and end sill; had engines take slack and back up suddenly but they failed to push the horn against the end sill.

I also made a test by placing a cup and saucer filled with coffee on the cushion in the cabin car and found very little of the coffee spilled while the train was in motion. I made the same experiment with cabin car coupled to cars, equipped with the old style Spring Draft Gear, and found the first time the train bunched that most of the coffee spilled. While I admit that we receive quite a number of shocks over 150,000 pounds, which the friction draft does not absorb, but to construct a friction draft gear which would stand 500,000 pounds during 2¼ inches compression would make the gear too rough for shocks which take place during ordinary service.

I would recommend that a draft gear with a maximum capacity of 200,000 pounds would answer the purpose.

MR. J. M. WAUGH: Mr. President and Gentlemen—There are one or two suggestions I would like to make. The experience of cars fitted with friction draft gears in service show a reduction in cost of maintenance which proves conclusively that we must have a cushion and an absorbing cushion at that. It should be as high as possible, so as to make it effective even with the present limit of travel. I quite agree with the remarks made in connection with short travel.

The first cost of equipping a car I don't think should be taken into consideration on a draft gear. The coupler has been made stronger by increasing its cross section and by making it of cast steel instead of malleable iron. In fact, the whole car is now materially reinforced compared with the constructions of five or six years ago.

You must either build the cars strong enough, so they cannot break, or put in cushions that will absorb or dissipate the blow and eliminate the shock.

In the last few years the cost of maintaining wooden freight cars has doubled, quadrupled, and in many cases increased beyond this; and as the paper stated, 75 per cent of the cost of maintenance can be traced directly or indirectly to the draft gear. On this basis the average cost of maintaining freight equipment in the last year, as shown by the annual reports, would equip every car in the United States with the best draft gear every year, besides saving money.

Then add to that the loss incident to extra hauling, loss in time and revenue, especially in the case of box cars, where 50 per cent of the repairs are above the floor line, and you will see where it lands you.

Why then should we not increase the travel as well as the resistance and have gears of 500,000 or 600,000 pounds with three or four inches motion instead of 150,000 to 200,000 pounds with 1¾″ to 2¼″ travel as at present? This would keep the coupler horn off the end sill in all cases, except with blows, great enough to wreck the car itself.

Of course, the amount of energy dissipated in shocks of that kind is simply the difference between the compression and the recoil, and therefore it seems that the ordinary coil spring is out of question and there is only one thing left, i. e., friction, abrasive and adhesive. On the other hand, many claim that friction gears are too rigid in their movement, and it would seem that an ideal gear should combine the two, a resiliant movement without recoil having an absorbent element based on friction.

MR. R. L. KLEINE: I cannot altogether agree with Mr. Waugh that first cost should not enter into the question. The total cost of the gear, which includes the first cost as well as the cost of maintenance, is the important item to a railroad company.

We kept a record of repairs to draft gears on both wooden and steel cars, and as I recall the figures now, about 25 per cent of the total cost of repairs to the wooden freight car equipment is traceable directly or indirectly to the draft gear. This would include the cost of repairs to center sills, end sills, draft timbers and the coupler attachments. As a comparison, we recorded the cost of steel car repairs equipped with a friction gear of the "parallel" type, referred to by Mr. Stucki, and we found the relative costs of the friction gears compared with the single spring gears on the wooden cars so low that the same were practically beyond comparison. It should, of course, be understood that the steel car has been constructed so much stronger than the wooden car that it is better able to withstand the heavy shocks received in service, and, therefore, these relative costs are not strictly comparative.

I do not believe it would be well to increase the capacity of the friction draft gear to such a point that it would dissipate any occasional shock to which it may be subjected, as it would involve increasing the capacity of all the gears to such an extent, which would possibly not be warranted by the increased cost. If the handling of the cars would be increased in the same ratio as the capacity of the gears, we would then be no better off than we are now. It would, however, seem that the capacity of our present draft gears, which range from 60,000 to 240,000 pounds, are a little low, but to what limits they should be increased, I am not prepared to state.

PRESIDENT: We have with us Mr. Wilson, Superintendent of Motive Power of the B. R. & P., and we will ask him to give us a word.

MR. W. H. WILSON: Mr. President—Mr. Stucki has certainly prepared an excellent paper on a very important subject, that can be best appreciated by those who have to do with the maintenance of equipment. He has paragraphed the paper extensively, more by way of inviting discussion more in detail. The paper appeals to me rather as one for reference than one for discussion.

The road with which I am connected uses extensively three well-known types of friction gear and no case of stuck gear or unexpected opening has been brought to my notice. We are using as a standard 2½" total coupler clearance without trouble and without any centering device.

PRESIDENT: We will ask Mr. Stucki to close the discussion with any comment that he wishes to make on matters that have been raised.

MR. A. STUCKI: I have really very little to add. I purposely left the history of the draft gear off, so as to keep the length of the paper within reasonable limits. For this reason the respective remarks of Mr. Reese were very appropriate. He and some other speakers mentioned repeatedly absorption of shocks. This we must clearly understand and constantly keep in mind, that there is no absorption of the initial shock, not a single pound, and the best we can do with friction is to absorb the back lash. With other words, the gear is yielding, still less elastic.

I am pleased to note that he agrees with me, that the ideal performance of a draft gear would be a uniformly increasing resistance throughout the total travel, excepting, of course, during the travel of the preliminary spring.

Why a draft gear has not as yet been placed between the engine and the tender lays undoubtedly in the desire to have as little movement as possible between the apron and the tender so as to facilitate matters for the fireman.

There is no doubt, as Mr. Harvey says, that the service is the best test after all. However, we must have means to get at the facts in a quicker way and to be able to eliminate the varying outside conditions of the service, in order to get at a true comparison. The static test is such a means. Besides this it gives you actually the same pressures for the same movement as in ordinary service. This is not only correct from a theoretical standpoint, but has been proven to be a fact by one of the gear manufacturers, who has made very careful tests in this respect. If you could get a gear without any weight at all, the two results would be exactly alike, while in the drop test a great deal of energy of the comparatively light drop is taken by the mass of the gear without ever reaching the anvil.

The springs under the anvil do not perform any function in the test. They were simply put there so as to exclude differences of the sub soil in different localities. Such a heavy anvil has been chosen, so that there actually would be no movement when the drop strikes, although it is resting on springs.

MR. GEORGE L. HARVEY: Doesn't the drop test compare very favorably with the engine test, where the coupler is rigid to the tender, or on the head end of the engine without any spring in it? Isn't the drop hammer test fairly comparable with that?

MR. A. STUCKI: I do not think so, because in one case you have a great mass, moving comparatively slow, while with the drop test you have a very small mass striking at a tremendous speed, so that the momentum of the gear plays a very important part.

The dead weight of the cars, it is true, has during the last fifteen years been greatly increased; however the proportion between dead weight and paying load has greatly been decreased.

We all agree that we can not build the different gears to one compression line, neither will the same gear always give the same line, but none the less we should know what is considered the best practice, so that everybody can work in this direction.

It is the heavy blow that breaks the car. But as Mr. Stark has pointed out, a shock may only start a fracture without being noticed, and without apparently hurting the car. But the damage is done and this initial fracture is sure to spread and to weaken other parts until the car is unsafe for the service.

To increase the travel to the extent as suggested by Mr. Waugh could not be done with the present standard construction, as the overhang for such a heavy coupler head is great already, and I am inclined to believe that a much better suggestion was made when it was pointed out that a fairer handling of the cars should be insisted on. This would remedy the evil just where it exists.

Friction is not the only medium which can be used to obtain a none-recoiling high-capacity draft gear. Liquids and other elements could be used, but so far none has proven to be practical.

My statement that 75 per cent of the wooden cars shopped had to undergo repairs on the draft gears or their attachments has been misunderstood. This percentage referred to the number of cars while the percentage of the cost is about 25 per cent, as correctly stated by Mr. Kleine. I thank you.

UPON MOTION, Adjourned.

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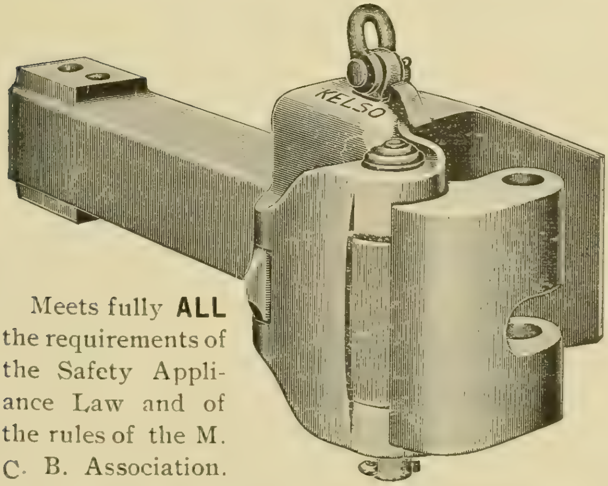

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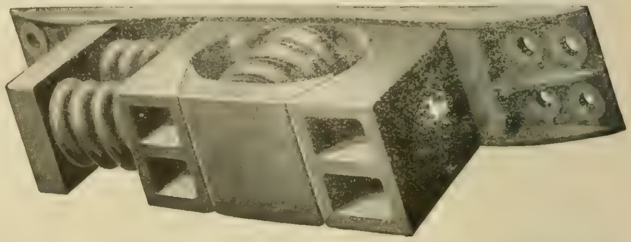

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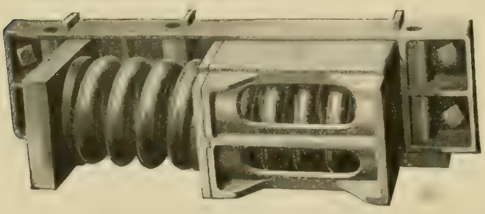

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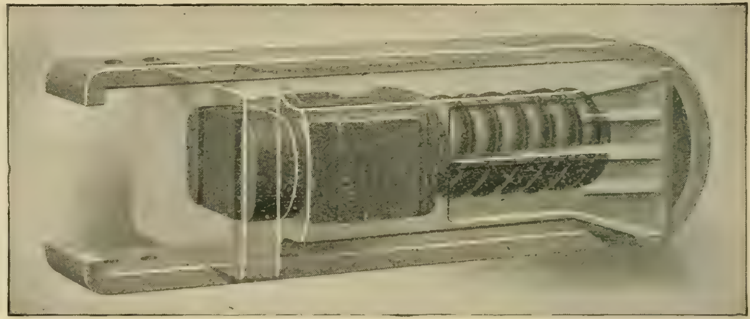

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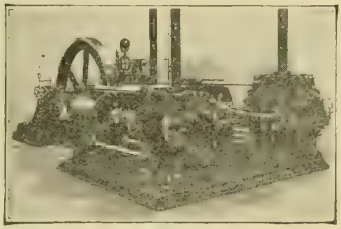

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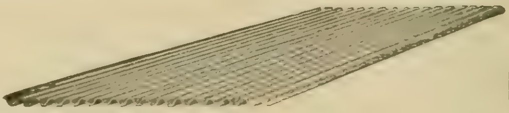

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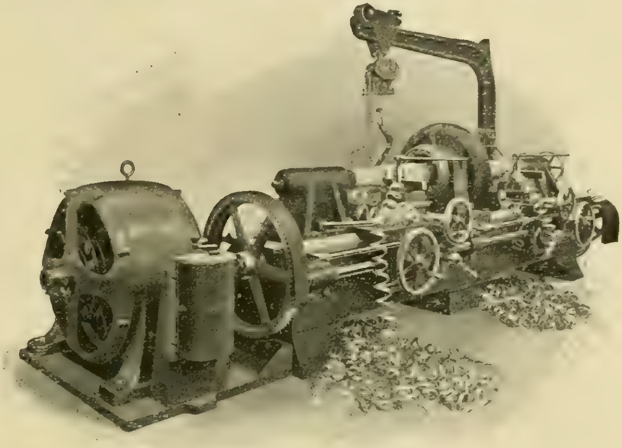

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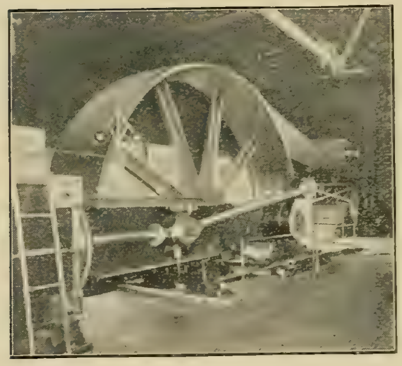

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*of the*

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ORGANIZED OCTOBER 18, 1901.

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VOL. VII.
No. 3.

Pittsburgh, Pa., Jan. 24, 1908.

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Published monthly, except June, July and August, by the Railway Club of Pittsburgh,
J. D. Conway, Secretary, General Offices P. & L. E. R. R., Pittsburgh, Pa.

*Meetings held fourth Friday each month, except June, July and August.*

## PROCEEDINGS OF MEETING,
## JANUARY 24th, 1908

The meeting was called to order at the Monongahela House, Pittsburgh, Pa., at 8 o'clock, P. M. with President H. W. Watts in the chair.

The following gentlemen registered:

## MEMBERS.

Alexander, J. R.
Atwood, J. A.
Bealor, B. G.
Bigham, C. G.
Blest, M. C.
Bollinger, C., Jr.
Brand, Thos.
Bruff, J. C.
Butts, G. W.
Cassidy, D. E.
Charles, John G.
Chittenden, A. D.
Cole, Jewett.
Courtney, D. C.
Conway, J. D.
Cox, P. L.
Curtis, H. C.
Dambach, C. O.
Dashiell, J. W.
Dawson, W. J., Jr.
Drayer, U. S.
Ferguson, Oliver G.
Gallaher, A. H.
Gallinger, Geo. A.
Gano, J. H.
Gardner, H.
Gibson, J. A.
Gilg, Henry F.
Gray, R.
Henderson, J. W.
Hetherington, S. C.
Hood, D. G.
Howe, D. M.
Irwin, O.
Jefferson, E. Z.
Kennedy, Jas.
Keyser, R. H.
Knickerbocker, A. C.
Kissinger, C. F.
Kinter, D. H.
Krause, Julius.
Langhorst, C. W.
Lent, John F.
Lobez, P. L.
Long, R. M.
Lortz, E. A.
Lowry, R. N.
Lynn, Samuel.
Malloy, M. A.
Mason, E. F.
Mavis, J. A.
Mawhinney, M. S.
Miller, C. W.
Minor, H. C.
Mitchell, A. G.
Murphy, W. J.
McConnell, C. H.
McGaughey, C. L.
McIlwain, J. D.
McKee, Frank W.
McMaster, H. W.
McMaster, R. T.
McNulty, F. M.
Neely, J. L.
Norton, D. S.
Oates, Geo. M.
Peach, W. M.
Pearce, R. M.
Platt, A. T.
Porter, H. V.

Redding, D. J.
Rinehart, H. W.
Ryan, W. F.
Sheck, H. G.
Shaler, Fred J.
Shannon, Chas.
Smith, M. A.
Stafford, B. E. D.
Stark, F. H.
Stewart, C. A.
Stucki, A.
Summers, E. W.
Sweeley, G. P.
Travis, O. H.
Tucker, John L.
Turner, L. H.
Warnock, H. R.
Watts, H. W.
Woodside, S. P.
Worthington, B. A.
Yohe, J. B.
Young, W. W.

## VISITORS.

Arthur, C. A.
Atwood, W. B.
Clark, John.
Clifford, M. J.
Code, J. G.
Deckman, E. J.
Douglas, H. T., Jr.
Gale, G. W.
Gray, C. B.
Griswold, W. W.
Hakanson, Walter.
Hasfield, W. G.
Hoest, H.
Hoopes, E. L.
Hurley, W. S.
Ireland, W. G.
Kull, W. A.
Mackenzie, P. E.
Mann, L. B.
Newsom, H. H.
Noble, H. S.
Porter, R. L.
Pringle, Arthur D.
Purdy, W. F.
Rauch, T. T.
Robbins, F. S.
Rohback, W. L.
Rutzky, B. E.
Smith, E. W.
Smith, Sion B.
Titus, A. P.
Walker, J. W.
Waring, F. M.

The minutes of the last meeting being in the hands of the printer, the reading of them was dispensed with.

The Secretary read the following list of proposals for membership:

Christiansen, A., Chief Engr., Standard Steel Car Co., Butler, Pa. Proposed by F. T. Reese.

Clark, Chas. H., Mech. Engr., E. W. Summers, Farmers Bank Bldg., Pittsburgh, Pa. Proposed by E. W. Summers.

Degener, P. A., Dempcy-Degener Co., Empire Bldg., Pittsburgh, Pa. Proposed by J. D. Conway.

Field, Arthur W., Genl. Sales Agent, Standard Motor Truck Co., Frick Annex, Pittsburgh, Pa. Proposed by F. T. Reese.

Fuller, Geo., Corning Draft Gear, Fisher Bldg., Chicago, Ill. Proposed by J. D. Conway.

Hurley, Wm. S., Yard Master, B. & O. R. R. Co., 4823 Blair St., Pittsburgh, Pa. Proposed by W. F. Ryan.

Lair, H. J., Fore. Car Dept., St. Clair Terminal R. R. Co., Blair Station, Pa. Proposed by A. A. Burkhard.

Lehr, Harry W., Asst. Fore. Car Insp., P. R. R., 224 Carver St., Pittsburgh, Pa. Proposed by Robert H. Blackall.

Nagle, Wm. E., Jr., Rep. Celfor Tool Co., Keenan Bldg., Pittsburgh, Pa. Proposed by D. J. Redding.

Sager, Wm. B., Yard Master, Monongahela R. R., Brownsville, Pa. Proposed by D. H. Kinter.

Speck, H. J., Genl. Foreman, P. C. C. & St. L. Ry. Co., Dennison, Ohio, Box 731. Proposed by J. T. Giles.

Taylor, C. A., Agent, Mineral Oil Paint Co., McChesney Bldg., Pittsburgh, Pa. Proposed by F. J. Reeve.

Wolf, Joseph C., Cashier Oliver Station, Penna. R. R. Co., 309 So. Third St., Duquesne, Pa. Proposed by S. N. Nickerson.

The President announced that an arrangement was agreed to whereby the officers were to meet each evening at the Hotel prior to the regular meetings for the consideration of any matters that might be of interest or to the advantage of the Club, and gave an account of the meeting of the officers this afternoon, and an outline of the work the committees expect to accomplish, calling especial attention to the fact that the advertising in the Proceedings form a considerable part of the financial support of the Club and asking members to interest themselves in securing advertising for the magazine.

The Secretary read a number of communications, among them the following:

PENNSYLVANIA LINES
West of Pittsburgh.

Pittsburgh, Pa., January 22, 1908.

Mr. J. D. Conway,
Secretary, Railway Club of Pittsburgh,
P. & L. E. R. R. Office, City.

Dear Sir:

Owing to absence from the office I am just in receipt of your very kind invitation to attend the banquet of the Club on Friday evening.

I regret exceedingly that a prior engagement will prevent my accepting the invitation and listening to Mr. Worthington's paper, which I am sure will be both interesting and instructive.

Such organizations as your Club, having meetings conducted on the lines you have adopted, are most valuable factors in the railway world and should receive every encouragement possible.

Yours truly,

A. B. STARR.

PRESIDENT: At our November meeting among those who took part in the discussion was our friend and fellow-member, Mr. A. W. Slocum. It was a distinct shock to all of us when we learned of his death. The Chair will appoint, with your permission, as a committee to prepare suitable memorial resolutions Messrs, Jas. D. Rhodes, J. W. Henderson and H. J. Gearhart.

We are particularly fortunate tonight, gentlemen, in having with us Mr. Worthington, and I will ask him now to read his paper.

MR. B. A. WORTHINGTON: Mr. President and Gentlemen:—Before beginning my paper I think it is only proper that I should render my apologies for my failure to be present at the meetings of the Club with more regularity since I have been a member. I do not know of any medium of exchange of railway ideas that is more valuable than that which is brought about through this Club and others like it. I have read the papers as they have appeared in the Proceedings from time to time with great interest, and the only excuse I can offer for my absence is that I spend a great deal of my time on the road and when I am in Pittsburg it has not always been convenient for me to attend as often as I would like to.

# TONNAGE RATING OF LOCOMOTIVES.

BY MR. B. A. WORTHINGTON, VICE PRES. AND GENL. MGR.
WABASH-PITTSBURGH TER. RY. CO.

The subject of tonnage rating of locomotives, as is well known, is one involving a great many complications, and for this reason no two railroads in the country today have adopted the same system, yet the bases underlying the various systems in use are practically the same.

A very simple and inexpensive system of engine rating can be prepared on a uniform basis, for any railroad, that will give excellent results in practice, with no cost for installation, excepting the mere expense of having the engine charts calculated and putting the system into effect, as hereinafter outlined.

With your kind indulgence, we shall subsequently go deeper into the subject and describe a more complete system of tonnage rating which has been in use for the past nine years on the Lines of the Southern Pacific Company, the installation of which was under my charge, and during a period of four years my attention was devoted exclusively to the work, including the making of train tests on the various divisions of the road, for the purpose of noting how closely our theoretical calculations checked with actual practice, before inaugurating what has since proved to be a very complete system of engine rating.

It is probably unnecessary to suggest that any system of engine rating that does not consider both elements, viz: *Speed* and *Load,* will not meet with modern railroad requirements. We are all familiar with the unfortunate experiences of railroads that have rated locomotives solely on the *tonnage* basis, regardless of the speed that the trains were required to make, the result being overloaded engines, excessive delays on the road, and utter demoralization of train service.

Perfection in train loading, however, is the greatest load that can be taken at the speed required, which, it follows, is the most economical load, and as the attainment of this object is fraught with many local complications, it is important that all of the factors which have a bearing on train movement *on each freight run* should be carefully considered.

Because of the varying conditions of weather, the changing conditions of a locomotive from good to poor, and the difference in the capacity and the fluctuating condition of car equipment, (the larger capacity cars having a higher load per axle, showing a lower resistance per ton of load than lighter capacity cars, as I will hereinafter explain), the question of engine rating is quite complex, and the very best that can be attained in practice is to use the best average results evolved from tests of acknowledged experts as a basis for engine loading.

Following this reasoning, let us assume:

*First*: That any system of calculation that is designed to reach a result which is based on mechanical law, using data for the premises obtained from a series of careful and practical tests, with appliances that give the measure of the results in tangible form for purposes of calculation, should be more nearly accurate than mere "guess-work," which was formerly the practice in engine loading before tonnage rating was established.

*Second*: It will probably be admitted by all mechanical experts that the traction of a locomotive, under stated conditions of piston speed and steam pressure, can be calculated.

*Third*: It has been demonstrated by mechanical experts that tests to determine train resistance, under varying conditions of service, can be accurately measured by a dynamometer, the sensitive machinery of which registers the pull on the draw bar.

*Fourth*: Mechanical engineers have demonstrated that indicator cards taken from locomotives will accurately show the maximum pressure on the piston at the beginning of the stroke, and will show the drop in the traction line as the piston advances, and when we have taken a number of these indicator cards from locomotives at varying speeds, an average mean effective pressure curve can be plotted, which will show the average working conditions. In fact, such data have been accepted by the Master Mechanics' Association of America and by the leading locomotive builders of the country, from which mean effective pressure curves have been plotted and adopted as standard.

Admitting these premises, let us now consider what data it is essential for us to have before us in formulating a system of locomotive tonnage rating.

In order that the relation between train speed, car load and engine power may be determined, it is necessary that the following factors should be considered:

*First*: A formula for showing the resistance in pounds per ton as affected by speed. (See Diagram No. 1.)

*Second*: A curve that will give the mean effective pressure of steam in the cylinders at different velocities. (See Diagram No. 2.)

*Third*: A curve to cover load allowance for empty and underloaded cars. (See Diagram No. 4.)

*Fourth*: A formula for determining the energy, or "momentum," stored up in a moving train, which experience has shown can be reconverted into work, without loss, and its amount for any given velocity can be accurately calculated.

*Fifth*: A formula for calculating the piston speed of locomotives for the purpose of connecting train speed with piston speed to apply to locomotives having different ratios of stroke to driver diameter.

*Sixth*: A locomotive rating chart (See Diagram No. 5) on the first five columns of which are deductions at varying speeds made from standard formulae for calculating:

1.—Piston speed.

2.—Velocity head.

3.—Engine traction.

4.—Train resistance—(Calculated from Angus Sinclair's formula).

As will be seen, this chart is based on the load in tons that can be pulled with each 1000 pounds of locomotive traction on varying grades at different velocities.

Taking up these factors seriatum:

*First*: *Train Resistance.*

For rating purposes on "drag" freight trains, it has been the practice to consider the load that can be hauled over the ruling gradient on a freight run at a speed of 10 miles per hour, for fast freight trains on Western roads at 15 miles per hour, and on some of our Eastern roads, the speed over limiting points with perishable freight trains, 20 miles per hour, the theory being that at all other points on the run where the grade is lighter, the engine can maintain a higher speed than over the ruling point.

Diagram No. 1 shows the Wellington, the Baldwin Locomotive and the Sinclair curves, these three curves being more generally adopted than others, although there have been a great many resistance curves made from various dynamometer tests.

The Southern Pacific Company uses the Wellington curve, and on the Wabash Lines East of Toledo we use the Sinclair curve, our principal reason being because it is more modern, the Wellington curve having been made in 1878 from tests on the Lake Shore & Michigan Southern Railway. The curve made by the *Engineering News* corresponds with data taken by Angus Sinclair with dynamometer car on the New York Central Lines. On page 265 of Henderson's Work on "Locomotive Operation," after a careful analysis of various resistance curves, Mr. Henderson suggests the curve of the *Engineering News* as being preferable to all others. However, for rating purposes, it is immaterial which of these curves we use, for the reason that the resistance in pounds per ton compares as follows:

*At* 10 *miles per hour.*

| | |
|---|---|
| Wellington | 4.80 pounds. |
| Engineering News | 4.50 pounds. |
| Baldwin | 4.66 pounds. |

*At* 15 *miles per hour.*

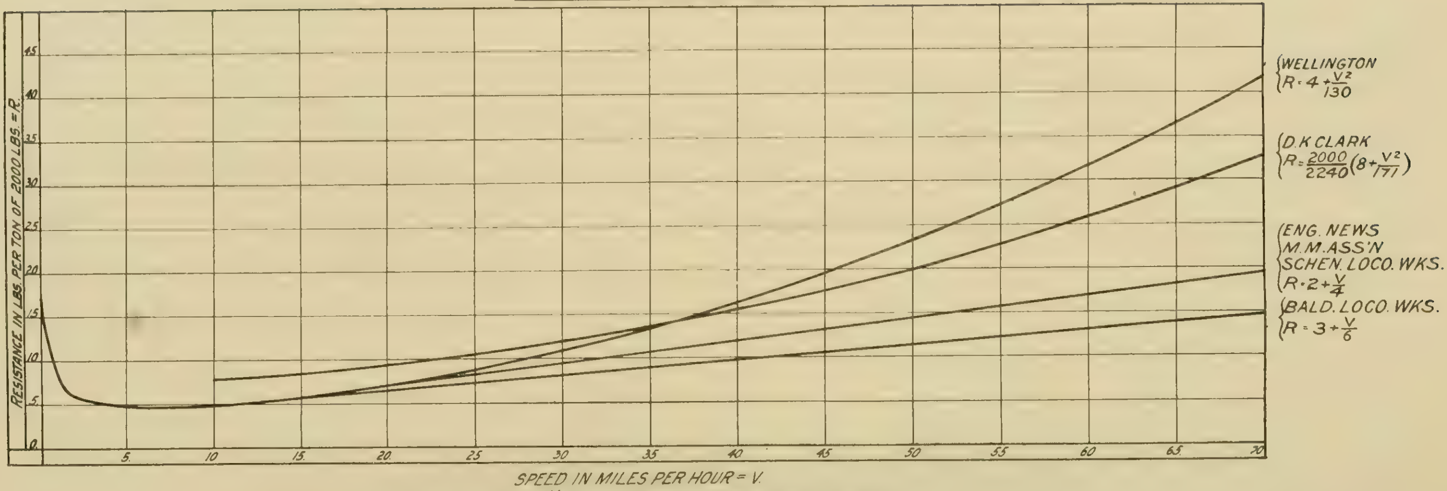
| | |
|---|---|
| Wellington | 5.70 pounds. |
| Engineering News | 5.75 pounds. |
| Baldwin | 5.50 pounds. |

*At* 20 *miles per hour.*

| | |
|---|---|
| Wellington | 7.07 pounds. |
| Engineering News | 7.00 pounds. |
| Baldwin | 6.33 pounds. |

From which it will appear that the difference in the load that could be carried (when we consider the gradient resistance over the limiting point, which is usually the greater part of train resistance), as between these three formulae, would be slight,

TRAIN RESISTANCE CURVES



FORMULA, $R = 2 + \frac{V}{4}$, SHOWS TESTS ON EMPIRE STATE EXPRESS
N.Y.C & H.R.R.R., by
Angus Sinclair.

Diagram No. 1.

especially at speeds of 10 and 15 miles per hour, and unless we go into the refinement of calculating speed lines over each freight run, it would be immaterial which of these resistance curves would be used.

If we should go into the elaboration of calculating speed lines, the same as was done by the Southern Pacific Company, the speed line made from the Baldwin curve would be faster than the *Engineering News curve,* and both of the curves would be faster than the Wellington curve, as the Wellington shows a greater resistance with the increasing speed, which would mean a slower speed line with the increasing velocity of the train.

It might be interesting for me to suggest, however, that in our train tests on the various divisions of the Southern Pacific Company, we were unable to make any better speed line between stations than the calculated speed line based on the Wellington curve, which would seem to justify the Southern Pacific Company in the use of the Wellington curve which checked so closely with their practice.

*Second: Mean Effective Pressure Curve.*

Diagram No. 2 shows the mean effective pressure curve adopted by Schenectady Locomotive works, which is taken at 85% of the boiler pressure, out to a piston speed of about 260 feet per minute. The curve of the Master Mechanics' Association is also shown taken at 80% of the boiler pressure out to a piston speed of about 220 feet per minute. The curve marked "Adopted" is a curve used by the Southern Pacific Company in their tonnage rating system. The higher line marked "S. P." shows the highest curve made from indicator cards taken in a series of tests on Southern Pacific locomotives. It will be noticed that the mean effective pressure curve adopted by the Southern Pacific Company falls about on the middle ground between the curves adopted by the Schenectady Locomotive Works and the Master Mechanics' Association, from which it would seem that, for average practice, it ought not to be far astray when placed midway between two such standard authorities. The circles shown at different points on this chart were made from indicator cards taken from various engines on the Southern Pacific Company lines. It might be argued that the engine that would show

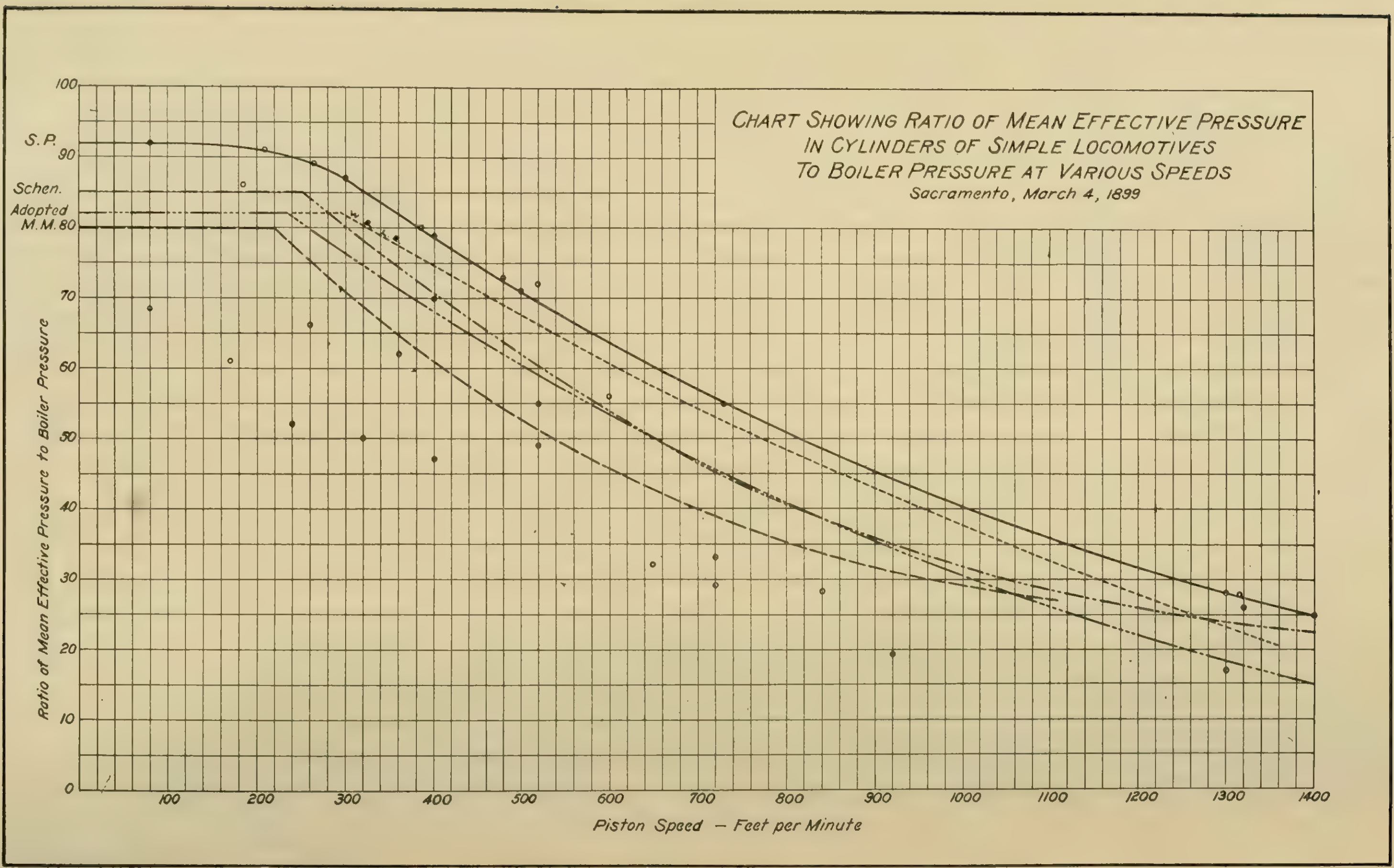


CHART SHOWING RATIO OF MEAN EFFECTIVE PRESSURE IN CYLINDERS OF SIMPLE LOCOMOTIVES TO BOILER PRESSURE AT VARIOUS SPEEDS
Sacramento, March 4, 1899

Diagram No. 2.

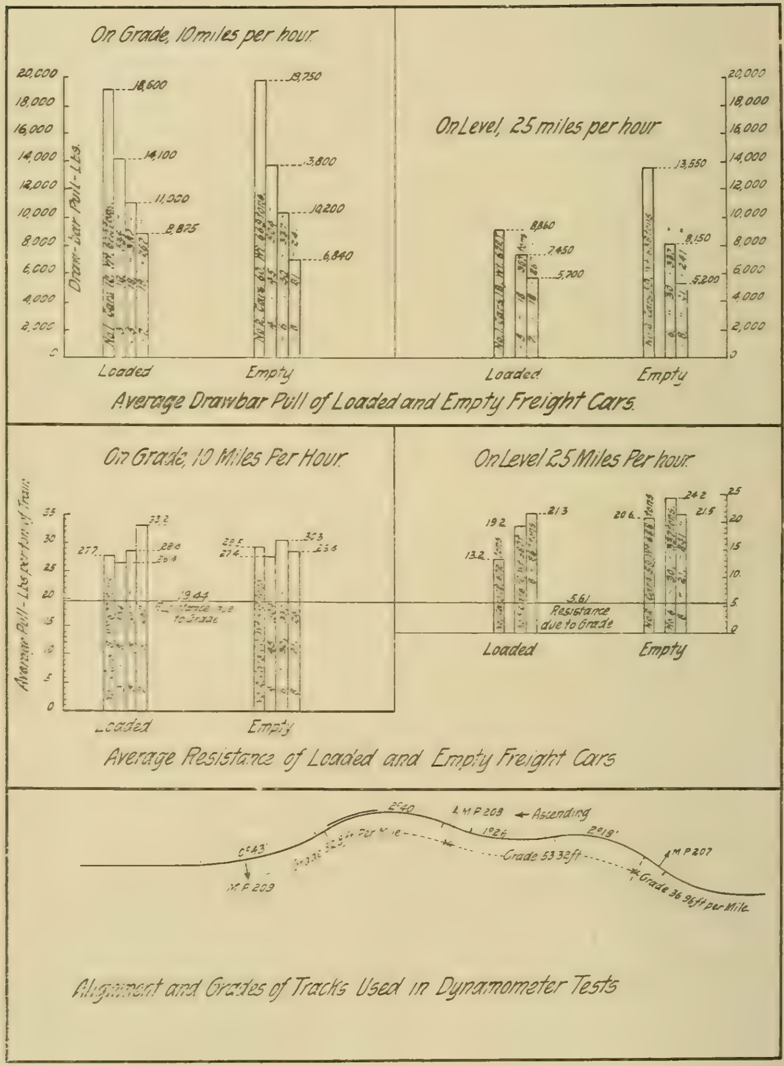
a low line as against the engine that made the high line would show a wide variation when we came to apply the average mean effective pressure curve for rating purposes. The answer to this is,—in any system of engine rating the system should be based on the type of freight engine that is most generally in use on the railroad, the piston speed of this particular type of engine being placed in column 1, diagram 5, and a co-efficient table prepared on a percentage basis, which can be easily done, based on the ratio of stroke to driver diameter, covering engines of different ratio from the type of engine which is used as the *basic* engine in the tonnage rating system. For compound locomotives, a mean effective pressure curve can be prepared by the use of the indicator, that can be used just the same as the curve adopted for simple engines, for the purpose of arriving at the traction of compound engines.

It might be interesting to note some tests made on the Northern Pacific some years ago by Mr. E. H. McHenry, one of the leading engineers of the country, showing the difference in the resistance per ton of an empty train, of a train loaded to two-thirds of its capacity, of a train loaded to one-third of its capacity, and of a fully loaded train on a 1% grade, compared with similar loads on a level track as shown by diagram No. 3. This chart speaks for itself and needs no explanation, as it fully confirms the theory laid down in the curve covering load allowance for empty and underloaded cars as shown on Diagram No. 4.

### *Third: Constructive weight allowance for empty and underloaded cars.*

The question of constructive weight allowance for empty and underloaded cars should be carefully considered, as this allowance should be considerably less on grades of 1%, or over, for the reason that only the rolling and atmospheric resistance are greater per weight unit of empty cars than per weight unit of loaded cars. Diagram No. 4 shows the curve covering load allowance for empty and underloaded cars that was adopted by the Southern Pacific Company.

The manner of application of this allowance is very simple. We have applied the same principle on the Wabash Lines East of Toledo. An extra column is provided for, on the face of



Average Drawbar Pull of Loaded and Empty Freight Cars.

Average Resistance of Loaded and Empty Freight Cars

Alignment and Grades of Tracks Used in Dynamometer Tests

Diagram No. 3.

Average Resistance of Loaded and Empty Freight Cars – Speed on Grade 10 Miles an Hour; on Level 25 Miles an Hour.

| Number of trip. | Number of cars. | Average lading per car. Lbs. | Total length of train. Ft. | Total weight of train. Tons.* | Dynamometer Record. | | | | | | Average pull in per cent. of locomotive capacity. (20,000 lbs.) | | Time in seconds for two miles. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Average drawbar pull. Lbs. | | Maximum drawbar pull. Lbs. | | Average resistance of train. Lbs. per ton. | | | | | |
| | | | | | Grade. | Level. | Grade. | Level. | Grade. | Level. | Grade. | Level. | Grade. | Level. |
| 1 | 18 | 43 261 | 689 | 672 | 18 600 | 8 860 | 22 630 | 12 600 | 27 7 | 13 2 | 93 | 44 3 | 791 | 27 |
| 2 | 60† | Empty | 1 928† | 669† | 19 750 | 13 550 | 22 300 | 15 950 | 29 5 | 20 6 | 98 7 | 67 8 | 769 | 28 |
| | | | | | | Difference........ ... | | ............... | 1 8 | 7 4 | | | | |
| 3 | 18 | 27 897 | 689 | 534 | 14 100 | ............. | 17 450 | ............ | 26 4 | ........... | 70 5 | ...... ..... | 760 | ........... |
| 4 | 45 | Empty | 1 440 | 504 | 13 800 | ............. | 15 300 | ............. | 27 4 | ........... | 69 5 | ........... | 747 | ........... |
| | | | | | | Difference .......... | | ............. | 1 0 | ........... | | | | |
| 5 | 18 | 13 280 | 689 | 387 | 11 000 | 7 450 | 13 800 | 9 600 | 28 4 | 19 2 | 55 | 37 2 | 792 | 290 |
| 6 | 30 | Empty | 953 | 337 | 10 200 | 8 150 | 12 000 | 10 350 | 30 3 | 24 2 | 51 | 40 7 | 835 | 292 |
| | | | | | | Difference ... ...... | | ............. | 1 9 | 5 0 | | | | |
| 7 | 18 | Empty | 689 | 267 | 8 875 | 5 700 | 10 800 | 8 000 | 33 2 | 21 3 | 44 4 | 28 5 | 830 | 281 |
| 8 | 21 | Empty | 673 | 241 | 6 840 | 5 200 | 8 800 | 6 600 | 28 4 | 21 5 | 34 2 | 26 0 | 793 | 288 |
| | | | | | | Difference .......... | | | 4 8 | 0 2 | | | | |

*Including the dynamometer car, but without the locomotive.

†No. 2 on the level consisted of 59 cars; length, 1,897 ft.; total weight, 658 tons.

*Railroad Gazette* 5-25-99

MWD
1109
E

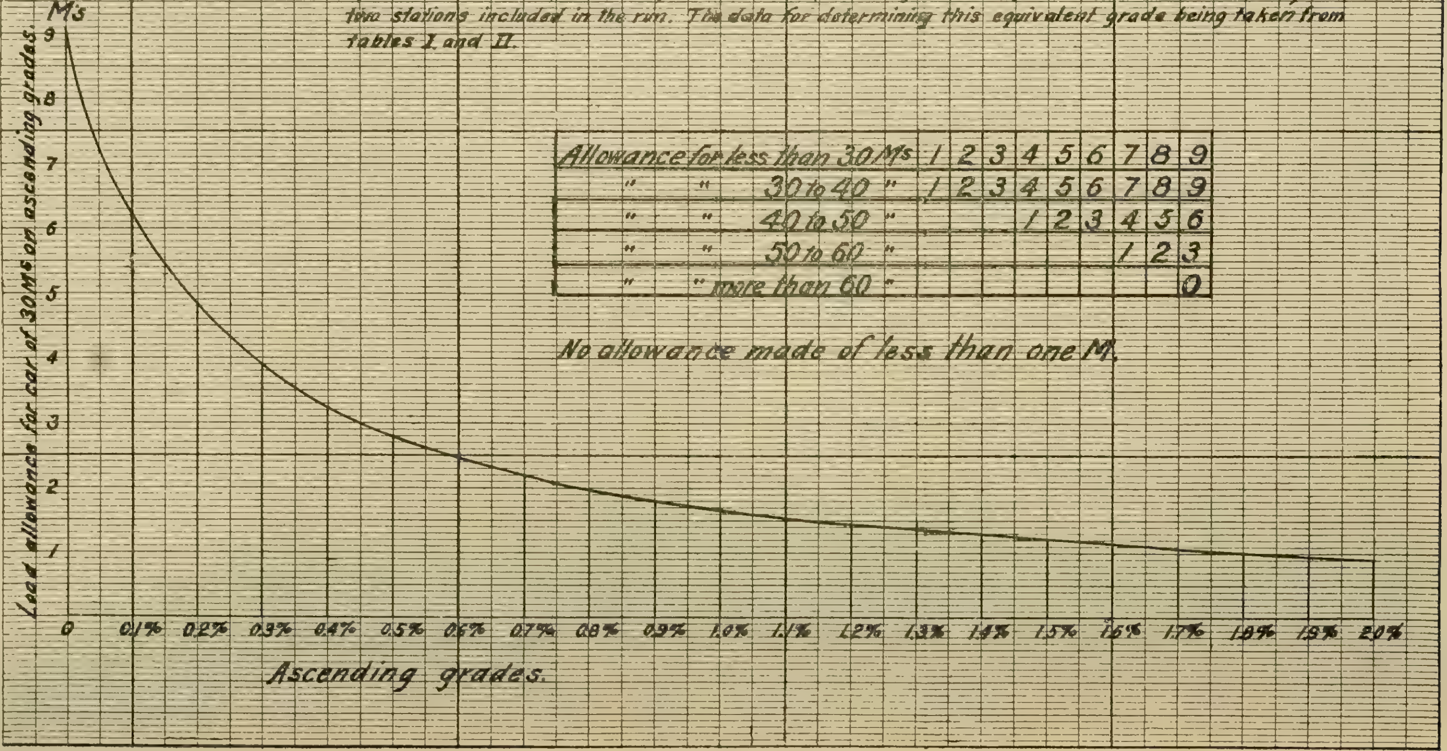
# Locomotive Rating

## Load allowance for empty and underloaded cars.

For each engine run the allowance for empty cars should be based on the ascending grade equivalent to the fastest average time made (with Engine working under steam) between any two stations included in the run. The data for determining this equivalent grade being taken from tables I and II.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Allowance for less than 30 M's | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| " " 30 to 40 " | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| " " 40 to 50 " | | | | 1 | 2 | 3 | 4 | 5 | 6 |
| " " 50 to 60 " | | | | | | | 1 | 2 | 3 |
| " " more than 60 " | | | | | | | | | 0 |

No allowance made of less than one M.



the Conductors' Tonnage Manifest blank, headed *"Constructive allowance for empty and underloaded cars."* On the back of the blank a small table is printed showing the allowance according to the gradient, which, on the main line of the Wheeling & Lake Erie, is as follows:

*Cnstructive allowance for Empty and Underloaded cars.*
(The allowance hereunder is based on the total weight of the car, viz: the *tare weight* plus the *weight* of the contents, if any.)
Allowance for car weighing less than 15 tons..........6 tons.
Allowance for car weighing from 15 to 20 tons........5 tons.
Allowance for car weighing from 20 to 25 tons........3 tons.
Allowance for car weighing more than 30 tons.........0 tons.

The Pennsylvania Railroad and some other Eastern lines obtained practically the same data as a basis, but applied the allowance in a different manner, as explained by Mr. D. F. Crawford, General Superintendent of Motive Power, in a paper presented at the December, 1901, meeting of the Western Railway Club, at which time he gave a diagram showing the resistance of cars of various weights. Their method of application is to decrease the tonnage of the train as the number of cars to make up the tonnage increases. As to which application is the better method, resolves itself into a question as to which is the simpler and more easily understood by the men in train and yard service.

*Fourth. A formula for determining the energy or momentum stored up in a moving train.*

Beginning with page 332 and running to page 373, inclusive, of *The Economic Theory of Railway Location,* by A. M. Wellington, is a very simple and complete treatise on the laws of accelerated and retarded motion and their effect on the movement of trains, from which it is quite clear that all energy or work communicated to any body must be employed either (1) in overcoming frictional or other resistances, or (2) stored up within the body in the form of an increase in velocity. This energy can be reconverted into work at any time without loss, and its amount for any given velocity may be very simply determined by the formula—

$$\text{Vel. head} = \frac{V^2 \text{ in feet per sec.}}{64.32} = \frac{1.467^2\, V^2 \text{ (in m. p. h.)}}{64.32} = 0.033445V^2$$

To which should be added 6.14 per cent for energy due to rotation of the wheels, making $0.002055V^2$ a total of $0.0355V^2$. A complete table of velocity heads, based on this formula, which was used in our calculations, appears on pages 335 and 336, table 118, *Wellington's Economic Theory of Railway Location.*

The figures shown in column 3 under the heading "Velocity head" on Diagram No. 5, were deduced from the Wellington formula. This formula, based on the square of the velocity in feet per second, divided by twice the gravity (the latter being taken at 32.16 feet per second) seems to have been accepted the world over as standard.

*Fifth: A formula for calculating the piston speed of locomotives.*

$$S = \frac{X\ 56\ L}{D}$$

$S =$ piston speed in feet per minute.
$X =$ miles per hour (train speed).
$D =$ diameter of driver in inches.
$L =$ length of piston stroke in inches.

This formula is based on mechanical law and is not subject to variation, the same as the resistance curve, or the curve covering mean effective pressure. It is needed to transform the curve of mean effective pressure as plotted for piston speed from feet per minute into engine speed for any locomotive in connection with Diagram No. 2 and in connection with the co-efficient table showing the relation in percentage that locomotives of different types bear to the *basic* engine that may be adopted.

For a simple system of engine rating that will give approximately correct results on a railroad where they have only one or two fast freight trains per day, where the factor of speed would not be so important as on a railroad running a large number of fast freight trains, the table shown on diagram No. 5, together with the usual motive power table showing the traction of engines (limiting the calculated traction for rating purposes at 25% of the driver weight so as to avoid over-loading over-cylindered engines), would be all that would be necessary to rate the engines.

It would seem, however, to be important to determine the load that could be taken with each 1000 pounds of locomotive traction on the ruling gradient of each freight run to be considered, in order that we might arrive at a *rating basis* for all the engines used on the run.

S = PISTON SPEED IN FT PER MIN
X = TRAIN SPEED IN MILES PER HOUR
D = DIAMETER OF DRIVERS IN INCHES
L = LENGTH OF PISTON STROKE IN INCHES
V = VELOCITY
g = ACCELERATION OF GRAVITY

$S = \frac{X\ 56\ L}{D}$

VELOCITY HEAD = $\frac{V^2 \text{ IN FT PER SEC}}{2g}$

TRACTIVE POWER = THAT TAKEN FROM AVERAGE LOCOMOTIVE

TRAIN RESISTANCE IN LBS PER TON = $2 + \frac{X \text{ IN MILES PER HR}}{4}$

Curve made by Angus [illegible] adopted by Master Mechanics Association [illegible]

GRADE RESISTANCE IN LBS PER TON = 20 × GRADE PER CENT

# LOCOMOTIVE RATING

W&LERR W.P.T.Ry. W.S.B.R.R.

TRAIN LOAD IN TONS, INCLUDING ENGINE, TENDER AND CARS WHICH CAN BE HAULED AT GIVEN SPEEDS ON GIVEN GRADES PER UNIT OF POWER BY A LOCOMOTIVE HAVING A 30" PISTON STROKE AND DRIVERS 57" IN DIAMETER.

ONE UNIT OF POWER = TRACTION EFFORT OF 1000 LBS AT POINT OF CONTACT BETWEEN DRIVING WHEELS AND RAILS

2000 LBS OF LOAD = 1 TON OF TRACTION

| 1 | 2 | 3 | 4 | 5 | | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 2 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PISTON SPEED FEET PER MIN | VELOCITY IN MILES PER HOUR | VELOCITY HEAD | TRACTIVE POWER | TRAIN RESIST. IN LBS PER TON | GRADE ACTUAL OR EQUIV. | LEVEL | +0.1 | +0.15 | +0.2 | +0.25 | +0.3 | +0.4 | +0.5 | +0.6 | +0.75 | +1.0 | +1.25 | +1.4 | +1.5 | +1.6 | +1.7 | +1.8 | +1.9 | +2.0 | +2.1 | +2.2 | +2.3 | +2.4 | +2.5 | +3.0 | +3.3 | -0.9 | 0.75 | -0.6 | -0.5 | 0.4 | 0.3 | -0.2 | -0.1 | -0.05 | VELOCITY IN MILES PER HOUR | PISTON SPEED FEET PER MIN |
| | | | | | GRADE RESIST PER TON | 0 | 2 | 3 | 4 | 5 | 6 | 8 | 10 | 12 | 15 | 20 | 25 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 60 | 66 | 18 | 15 | 12 | 10 | 8 | 6 | 4 | 2 | 1 | | |
| 295 | 10 | 3$^5$ | 1000 | 4$^5$ | | 222 | 154 | 133 | 118 | 105 | 95 | 80 | 69 | 60$^6$ | 51 | 40$^8$ | 34 | 30$^8$ | 29 | 27$^4$ | 26 | 24$^7$ | 23$^5$ | 22$^5$ | 21$^5$ | 20$^6$ | 19$^8$ | 19$^2$ | 18$^4$ | 15$^5$ | 14$^2$ | | | | | | | | 400 | 276 | 10 | 295 |
| 324 | 11 | 4$^3$ | 975 | 4$^{75}$ | | 205 | 145 | 126 | 111 | 100 | 90$^7$ | 76$^5$ | 66 | 58 | 49$^4$ | 39$^5$ | 32$^8$ | 29$^8$ | 28 | 26$^5$ | 25$^2$ | 24 | 22$^8$ | 21$^6$ | 20$^8$ | 20 | 19$^2$ | 18$^5$ | 17$^8$ | 15 | 13$^8$ | | | | | | | | 354 | 260 | 11 | 324 |
| 354 | 12 | 5$^1$ | 950 | 5 | | 190 | 136 | 119 | 105 | 95 | 86$^4$ | 73 | 63$^3$ | 56 | 47$^5$ | 38 | 31$^7$ | 28$^8$ | 27 | 25$^7$ | 24$^4$ | 23$^2$ | 22 | 21 | 20$^2$ | 19$^4$ | 18$^6$ | 17$^9$ | 17$^3$ | 14$^6$ | 13$^4$ | | | | | | | | 317 | 238 | 12 | 354 |
| 383 | 13 | 6 | 925 | 5$^{25}$ | | 176 | 128 | 112 | 100 | 90 | 82 | 69$^8$ | 60$^6$ | 53$^6$ | 45$^7$ | 36$^7$ | 30$^6$ | 27$^8$ | 26$^2$ | 24$^8$ | 23$^6$ | 22$^4$ | 21$^4$ | 20$^4$ | 19$^5$ | 18$^8$ | 18 | 17$^4$ | 16$^7$ | 14$^2$ | 13 | | | | | | | | 285 | 216 | 13 | 383 |
| 413 | 14 | 7 | 900 | 5$^{50}$ | | 164 | 120 | 106 | 95 | 86 | 78$^3$ | 66$^6$ | 58 | 51$^5$ | 43$^8$ | 35$^3$ | 30 | 26$^9$ | 25$^7$ | 24 | 22$^7$ | 21$^7$ | 20$^7$ | 19$^8$ | 19 | 18$^2$ | 17$^5$ | 16$^8$ | 16$^2$ | 13$^7$ | 12$^6$ | | | | | | | | 257 | 200 | 14 | 413 |
| 442 | 15 | 8 | 875 | 5$^{75}$ | | 152 | 113 | 100 | 90 | 81$^5$ | 74$^5$ | 63$^7$ | 55$^5$ | 49$^4$ | 42$^2$ | 34 | 28$^5$ | 26 | 24$^5$ | 23$^2$ | 22 | 21 | 20 | 19$^2$ | 18$^3$ | 17$^6$ | 16$^9$ | 16$^3$ | 15$^7$ | 13$^3$ | 12$^2$ | | | | | | | | 234 | 185 | 15 | 442 |
| 472 | 16 | 9 | 850 | 6 | | 141 | 106 | 94$^5$ | 85 | 77$^3$ | 70$^8$ | 60$^6$ | 53 | 47$^2$ | 40$^4$ | 32$^6$ | 27$^4$ | 25 | 23$^6$ | 22$^4$ | 21$^2$ | 20$^2$ | 19$^3$ | 18$^4$ | 17$^7$ | 17 | 16$^3$ | 15$^7$ | 15$^2$ | 12$^9$ | 11$^8$ | | | | | | | | 213 | 170 | 16 | 472 |
| 501 | 17 | 10$^3$ | 825 | 6$^{25}$ | | 132 | 100 | 89 | 80$^5$ | 73$^3$ | 67$^3$ | 57$^8$ | 50$^7$ | 45 | 38$^5$ | 31$^4$ | 26$^4$ | 24 | 22$^8$ | 21$^6$ | 20$^5$ | 19$^5$ | 18$^6$ | 17$^8$ | 17$^1$ | 16$^4$ | 15$^8$ | 15$^2$ | 14$^7$ | 12$^5$ | 11$^4$ | | | | | | | 357 | 194 | 157 | 17 | 501 |
| 530 | 18 | 11$^5$ | 800 | 6$^{50}$ | | 123 | 94 | 84$^1$ | 76 | 69$^7$ | 64 | 55 | 48$^4$ | 43$^1$ | 37$^2$ | 30$^2$ | 25$^4$ | 23$^2$ | 21$^8$ | 20$^4$ | 19$^7$ | 18$^8$ | 17$^9$ | 17$^2$ | 16$^5$ | 15$^8$ | 15$^2$ | 14$^7$ | 14$^1$ | 12 | 11 | | | | | | | 320 | 178 | 145 | 18 | 530 |
| 560 | 19 | 12$^8$ | 775 | 6$^{75}$ | | 115 | 88$^5$ | 79$^5$ | 72 | 66 | 60$^8$ | 52$^5$ | 46$^3$ | 41$^3$ | 35$^6$ | 29 | 24$^4$ | 22$^3$ | 21$^1$ | 20 | 19 | 18$^1$ | 17$^3$ | 16$^6$ | 15$^9$ | 15$^3$ | 14$^7$ | 14$^2$ | 13$^7$ | 11$^6$ | 10$^6$ | | | | | | | 282 | 163 | 135 | 19 | 560 |
| 589 | 20 | 14$^2$ | 750 | 7 | | 107 | 83$^3$ | 75 | 68 | 62$^5$ | 57$^6$ | 50 | 44$^1$ | 39$^5$ | 34 | 27$^6$ | 23$^4$ | 21$^4$ | 20$^3$ | 19$^2$ | 18$^3$ | 17$^4$ | 16$^7$ | 15$^9$ | 15$^3$ | 14$^7$ | 14$^2$ | 13$^6$ | 13$^4$ | 11$^2$ | 10$^3$ | | | | | | | 250 | 150 | 125 | 20 | 589 |
| 619 | 21 | 15$^7$ | 725 | 7$^{25}$ | | 100 | 78$^4$ | 70$^7$ | 64$^5$ | 59 | 54$^7$ | 47$^5$ | 42 | 37$^6$ | 32$^3$ | 26$^5$ | 22$^5$ | 20$^3$ | 19$^5$ | 18$^3$ | 17$^5$ | 16$^7$ | 16 | 15$^3$ | 14$^7$ | 14$^2$ | 13$^6$ | 13$^1$ | 12$^6$ | 10$^8$ | 9$^9$ | | | | | | | 221 | 138 | 116 | 21 | 619 |
| 648 | 22 | 17$^2$ | 700 | 7$^{50}$ | | 93 | 74 | 66$^7$ | 61 | 56 | 52 | 45 | 40 | 36 | 31 | 25$^5$ | 21$^6$ | 19$^7$ | 18$^7$ | 17$^7$ | 16$^9$ | 16$^1$ | 15$^4$ | 14$^7$ | 14$^2$ | 13$^6$ | 13 | 12$^6$ | 12$^4$ | 10$^4$ | 9$^5$ | | | | | | 453 | 200 | 127 | 108 | 22 | 648 |
| 678 | 23 | 18$^8$ | 675 | 7$^{75}$ | | 87 | 69$^3$ | 62$^8$ | 57$^4$ | 53 | 49 | 43 | 38 | 34 | 29$^6$ | 24$^4$ | 20$^6$ | 18$^9$ | 17$^9$ | 17 | 16$^2$ | 15$^5$ | 14$^8$ | 14$^2$ | 13$^6$ | 13 | 12$^6$ | 12$^1$ | 11$^7$ | 10 | 9$^2$ | | | | | | 386 | 180 | 117 | 100 | 23 | 678 |
| 707 | 24 | 20$^5$ | 655 | 8 | | 82 | 65$^5$ | 59$^5$ | 54$^5$ | 50$^4$ | 47 | 41 | 36$^4$ | 32$^8$ | 28$^5$ | 23$^4$ | 19$^9$ | 18$^2$ | 17$^3$ | 16$^4$ | 15$^6$ | 14$^9$ | 14$^3$ | 13$^7$ | 13$^1$ | 12$^6$ | 12$^1$ | 11$^7$ | 11$^3$ | 9$^6$ | 8$^9$ | | | | | | 328 | 164 | 109 | 94 | 24 | 707 |
| 737 | 25 | 22$^2$ | 635 | 8$^{25}$ | | 77 | 62 | 56$^5$ | 51$^8$ | 48 | 44$^5$ | 39 | 34$^8$ | 31$^4$ | 27$^4$ | 22$^5$ | 19$^1$ | 17$^5$ | 16$^6$ | 15$^8$ | 15 | 14$^4$ | 13$^8$ | 13$^2$ | 12$^6$ | 12$^2$ | 11$^7$ | 11$^3$ | 10$^9$ | 9$^3$ | 8$^0$ | | | | | | 283 | 150 | 102 | 88 | 25 | 737 |
| 766 | 26 | 24 | 615 | 8$^{50}$ | | 72$^5$ | 58$^5$ | 53$^5$ | 49 | 45$^5$ | 42$^5$ | 37$^4$ | 33$^2$ | 30 | 26$^2$ | 21$^6$ | 18$^4$ | 16$^8$ | 16 | 15$^2$ | 14$^5$ | 13$^8$ | 13$^2$ | 12$^7$ | 12$^2$ | 11$^7$ | 11$^3$ | 10$^9$ | 10$^5$ | 9 | 8$^3$ | | | | | | 246 | 137 | 95 | 82 | 26 | 766 |
| 796 | 27 | 25$^9$ | 595 | 8$^{75}$ | | 68 | 55$^6$ | 50$^5$ | 46$^7$ | 43$^3$ | 40$^5$ | 35$^5$ | 31$^8$ | 28$^6$ | 25 | 20$^7$ | 17$^6$ | 16$^2$ | 15$^4$ | 14$^6$ | 13$^9$ | 13$^3$ | 12$^7$ | 12$^2$ | 11$^7$ | 11$^3$ | 10$^9$ | 10$^5$ | 10$^1$ | 8$^7$ | 8 | | | | | 795 | 217 | 125 | 88 | 77 | 27 | 796 |
| 825 | 28 | 27$^8$ | 575 | 9 | | 64 | 52$^3$ | 48 | 44 | 41 | 38$^4$ | 34 | 30$^3$ | 27$^4$ | 24 | 19$^8$ | 17 | 15$^5$ | 14$^8$ | 14 | 13$^4$ | 12$^8$ | 12$^2$ | 11$^7$ | 11$^3$ | 10$^9$ | 10$^5$ | 10$^1$ | 9$^8$ | 8$^4$ | 7$^7$ | | | | | 575 | 192 | 115 | 82 | 72 | 28 | 825 |
| 855 | 29 | 29$^9$ | 555 | 9$^{25}$ | | 60 | 49$^3$ | 45$^3$ | 42 | 39 | 36$^4$ | 32$^2$ | 28$^8$ | 26$^1$ | 22$^9$ | 19 | 16$^2$ | 14$^9$ | 14$^2$ | 13$^4$ | 12$^8$ | 12$^3$ | 11$^8$ | 11$^3$ | 10$^8$ | 10$^4$ | 10 | 9$^7$ | 9$^4$ | 8 | 7$^4$ | | | | | 444 | 171 | 106 | 77 | 67 | 29 | 855 |
| 884 | 30 | 32 | 535 | 9$^{50}$ | | 56$^4$ | 46$^5$ | 42$^8$ | 39$^6$ | 37 | 34$^6$ | 30$^6$ | 27$^4$ | 24$^9$ | 21$^8$ | 18$^2$ | 15$^5$ | 14$^3$ | 13$^5$ | 12$^9$ | 12$^3$ | 11$^8$ | 11$^3$ | 10$^8$ | 10$^4$ | 10 | 9$^6$ | 9$^3$ | 9 | 7$^7$ | 7$^1$ | | | | | 356 | 153 | 97 | 71 | 63 | 30 | 884 |
| 914 | 31 | 34 | 515 | 9$^{75}$ | | 53 | 44 | 40$^4$ | 37$^4$ | 35 | 32$^8$ | 29 | 26 | 23$^8$ | 20$^8$ | 17$^3$ | 14$^8$ | 13$^7$ | 13 | 12$^3$ | 11$^8$ | 11$^3$ | 10$^8$ | 10$^4$ | 10 | 9$^6$ | 9$^2$ | 8$^9$ | 8$^6$ | 7$^4$ | 6$^8$ | | | | | 294 | 137 | 90 | 67 | 59 | 31 | 914 |
| 943 | 32 | 36$^4$ | 495 | 10 | | 49$^5$ | 41 | 38 | 35$^4$ | 33 | 31 | 27$^5$ | 24$^8$ | 22$^5$ | 19$^8$ | 16$^5$ | 14$^2$ | 13 | 12$^4$ | 11$^8$ | 11$^3$ | 10$^8$ | 10$^3$ | 9$^9$ | 9$^5$ | 9$^2$ | 8$^9$ | 8$^5$ | 8$^3$ | 7$^1$ | 6$^5$ | | | | | 248 | 124 | 83 | 62 | 55 | 32 | 943 |
| 973 | 33 | 38$^7$ | 475 | 10$^{25}$ | | 46$^3$ | 38$^8$ | 35$^8$ | 33$^4$ | 31$^2$ | 29$^2$ | 26 | 23$^4$ | 21$^4$ | 18$^8$ | 15$^7$ | 13$^5$ | 12$^4$ | 11$^8$ | 11$^3$ | 10$^7$ | 10$^3$ | 9$^9$ | 9$^5$ | 9$^1$ | 8$^8$ | 8$^5$ | 8$^2$ | 7$^9$ | 6$^8$ | 6$^2$ | | | | | 211 | 112 | 76 | 58 | 51 | 33 | 973 |
| 1002 | 34 | 41 | 455 | 10$^{50}$ | | 43$^3$ | 36$^4$ | 33$^7$ | 31$^4$ | 28$^4$ | 27$^6$ | 24$^6$ | 22$^2$ | 20$^2$ | 17$^8$ | 14$^9$ | 12$^8$ | 11$^8$ | 11$^3$ | 10$^7$ | 10$^2$ | 9$^8$ | 9$^4$ | 9 | 8$^7$ | 8$^4$ | 8$^1$ | 7$^8$ | 7$^5$ | 6$^5$ | 6 | | | | 910 | 182 | 101 | 70 | 54 | 48 | 34 | 1002 |
| 1031 | 35 | 43$^6$ | 436 | 10$^{75}$ | | 40$^5$ | 34 | 31$^7$ | 29$^6$ | 27$^7$ | 26 | 23$^2$ | 21 | 19$^2$ | 17 | 14$^2$ | 12$^2$ | 11$^3$ | 10$^7$ | 10$^2$ | 9$^8$ | 9$^3$ | 9 | 8$^6$ | 8$^3$ | 8 | 7$^7$ | 7$^4$ | 7$^2$ | 6$^2$ | 5$^7$ | | | | 580 | 158 | 92 | 65 | 50 | 45 | 35 | 1031 |
| 1061 | 36 | 46 | 417 | 11 | | 38 | 32 | 29$^8$ | 27$^8$ | 26 | 24$^6$ | 22 | 19$^9$ | 18$^1$ | 16 | 13$^5$ | 11$^6$ | 10$^7$ | 10$^2$ | 9$^7$ | 9$^3$ | 8$^9$ | 8$^5$ | 8$^2$ | 7$^9$ | 7$^6$ | 7$^3$ | 7$^1$ | 6$^8$ | 5$^9$ | 5$^4$ | | | | 417 | 139 | 84 | 60 | 46 | 42 | 36 | 1061 |
| 1090 | 37 | 48$^5$ | 398 | 11$^{25}$ | | 35$^4$ | 30 | 28 | 26$^1$ | 24$^5$ | 23 | 20$^7$ | 18$^7$ | 17 | 15$^2$ | 12$^7$ | 11 | 10$^1$ | 9$^7$ | 9$^2$ | 8$^8$ | 8$^4$ | 8$^1$ | 7$^8$ | 7$^5$ | 7$^2$ | 7 | 6$^7$ | 6$^5$ | 5$^6$ | 5$^2$ | | | | 318 | 123 | 76 | 55 | 43 | 39 | 37 | 1090 |
| 1120 | 38 | 51$^3$ | 378 | 11$^{50}$ | | 33 | 28 | 26 | 24$^4$ | 23 | 21$^6$ | 19$^4$ | 17$^6$ | 16$^1$ | 14$^3$ | 12 | 10$^7$ | | | | | | | | | | | | | | | | | | 252 | 108 | 69 | 50 | 40 | 36 | 38 | 1120 |
| 1149 | 39 | 54 | 363 | 11$^{75}$ | | 30$^4$ | 26$^4$ | 24$^6$ | 23 | 21$^6$ | 20$^4$ | 18$^4$ | 16$^7$ | 15$^6$ | 13$^6$ | 11$^8$ | 9$^9$ | | | | | | | | | | | | | | | | | | 208 | 97 | 63 | 47 | 37 | 34 | 39 | 1149 |
| 1179 | 40 | 56$^8$ | 347 | 12 | | 29 | 24$^8$ | 23 | 21$^7$ | 20$^4$ | 19$^3$ | 17$^3$ | 15$^6$ | 14$^5$ | 12$^8$ | 10$^8$ | 9$^4$ | | | | | | | | | | | | | | | | | | 174 | 87 | 58 | 43 | 35 | 32 | 40 | 1179 |
| 1208 | 41 | 59$^7$ | 331 | 12$^{25}$ | | 27 | 23$^3$ | 21$^8$ | 20$^4$ | 19$^2$ | 18$^2$ | 16$^4$ | 14$^9$ | 13$^7$ | 12$^2$ | 10$^3$ | 8$^9$ | | | | | | | | | | | | | | | | | | 148 | 78 | 53 | 40 | 32 | 30 | 41 | 1208 |
| 1238 | 42 | 62$^6$ | 316 | 12$^{50}$ | | 25 | 21$^8$ | 20$^4$ | 19$^2$ | 18 | 17 | 15$^4$ | 14 | 12$^9$ | 11$^5$ | 9$^7$ | 8$^4$ | | | | | | | | | | | | | | | | | 632 | 126 | 70 | 49 | 37 | 30 | 28 | 42 | 1238 |
| 1267 | 43 | 65$^6$ | 301 | 12$^{75}$ | | 23$^6$ | 20$^4$ | 19$^1$ | 18 | 17 | 16 | 14$^5$ | 13$^2$ | 12$^2$ | 10$^5$ | 9$^2$ | | | | | | | | | | | | | | | | | | 400 | 110 | 63 | 45 | 34 | 28 | 26 | 43 | 1267 |
| 1297 | 44 | 68$^7$ | 285 | 13 | | 22 | 19 | 17$^8$ | 16$^8$ | 15$^8$ | 15 | 13$^6$ | 12$^4$ | 11$^4$ | 10$^2$ | 8$^7$ | | | | | | | | | | | | | | | | | | 285 | 95 | 57 | 41 | 32 | 26 | 24 | 44 | 1297 |
| 1326 | 45 | 72 | 270 | 13$^{25}$ | | 20$^4$ | 17$^7$ | 16$^6$ | 15$^6$ | 14$^8$ | 14 | 12$^7$ | 11$^7$ | 10$^7$ | 9$^6$ | 8$^1$ | | | | | | | | | | | | | | | | | | 220 | 83 | 51 | 37 | 29 | 24 | 22 | 45 | 1326 |
| 1356 | 46 | 75 | 254 | 13$^{50}$ | | 18$^8$ | 16$^4$ | 15$^4$ | 14$^5$ | 13$^7$ | 13 | 11$^5$ | 10$^8$ | 10 | | | | | | | | | | | | | | | | | | | | 117 | 73 | 46 | 34 | 27 | 22 | 20 | 46 | 1356 |

Diagram No. 5.

Suppose for example, we had a +0.5 grade over the ruling section, and we desire to go over the ruling gradient at a speed of 15 miles per hour.

By reference to chart No. 5, it will be seen that on a +0.5 grade we can haul 55.5 tons at a speed of 15 miles per hour with each 1000 pounds of traction. If we have a consolidation engine with 40,000 pounds of traction, the calculation is quite simple, being 40 times 55.5 tons, or 2,200 tons, and if we assume that the engine and tender weigh 200 tons, the net rating of such a locomotive, at 15 miles per hour over the +0.5 grade, would be 2,000 tons.

The next question that will suggest itself in making a rating for a freight run is, how to distinguish between what may fairly be considered a *momentum* as against a *ruling* gradient.

This question is easily settled by ascertaining the change in elevation from the foot of the grade, to be considered, to the top of the grade, and ascertain by tests, or otherwise, what speed can be attained on arriving at the foot of the grade.

For example, let us assume that the change in elevation on a +0.5 grade is 32 feet (see column 3, diagram No. 5), and the physical conditions are such that we could easily attain a speed of 30 miles per hour at the foot of the grade; in that event, we need not consider this +0.5 grade the limiting point on the run, and if we could attain a speed of 35 miles per hour at the foot of the grade, we could surmount a change in elevation of 43.6 feet, from which it will appear that it is quite simple, if we study the profile of the line, to determine which are *momentum* and which must be considered *ruling* grades.

With these data, and with the profile of a given freight run before us, showing the physical characteristics to be overcome, we can readily calculate a *rating basis* to show the number of tons per unit of locomotive power that should be moved over the limiting point at any desired speed, and the advantage of having a *rating basis* on each freight run is that all engines of different types, running in this same service shall have exactly the same load per each unit of 1000 pounds of locomotive traction, which would seem to be sound principle, on the assumption that the engines are required to perform the same service.

If you should ask a modern motive power superintendent of almost any of the large railroads of the country if 1000 pounds of locomotive traction in one engine is not just as effective for working purposes as in another engine, he will answer you, truthfully, that engines built 10 or 15 years ago have not the same boiler capacity as the more modern engines, and for this reason we should not expect to get the same work out of 1000 pounds of locomotive traction in locomotives built a decade ago as we should with modern locomotives with larger boiler capacity. While this theory looks logical, it does not work out in practice. If we analyze the ratings of locomotives on different railroads, including railroads that have gone deeply into this subject, spending thousands of dollars making tests with dynamometer cars, the strange fact will be brought out that engines built 10 and 15 years ago are actually rated to haul more tonnage with each 1000 pounds of locomotive traction than modern engines.

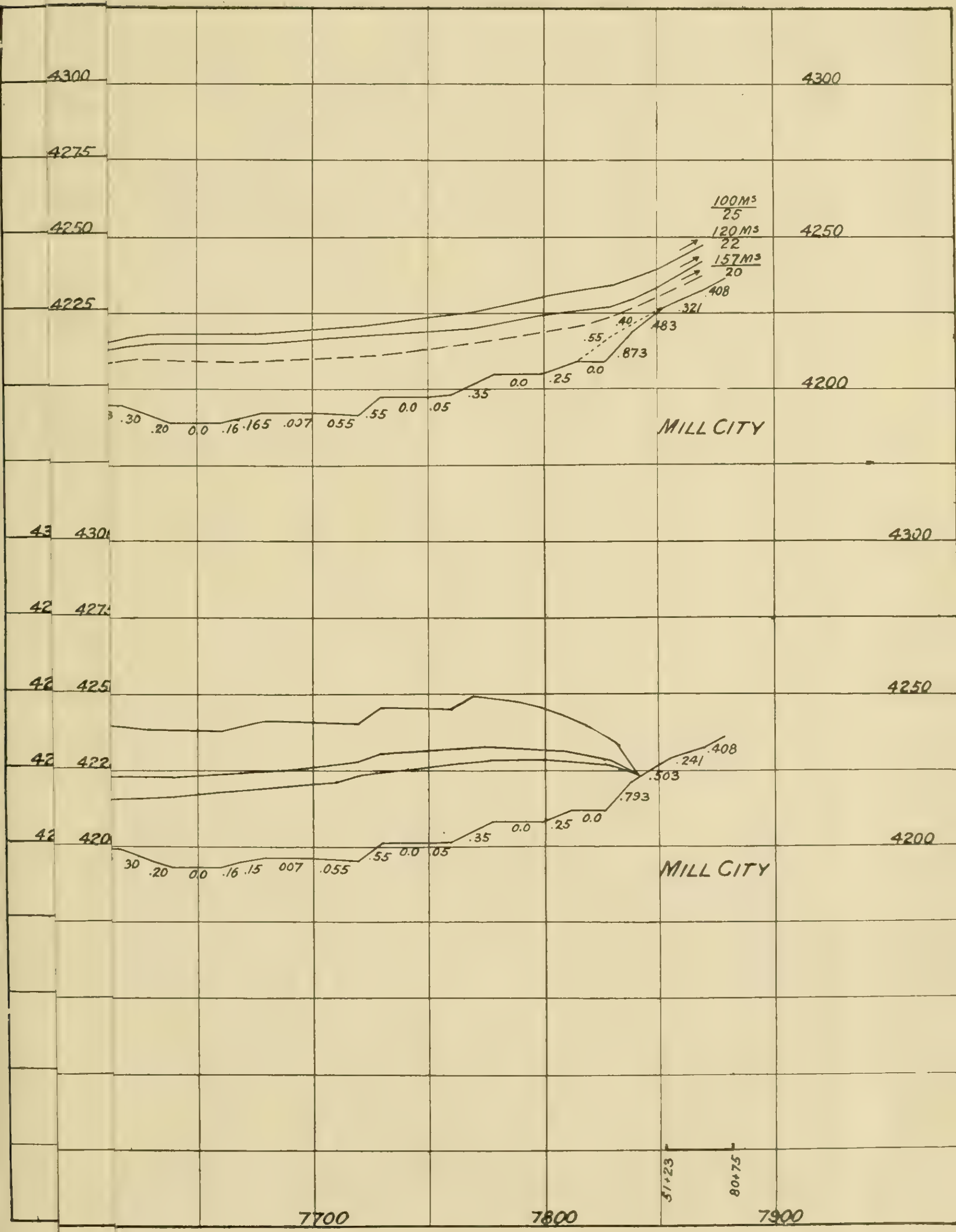
Not by way of criticism, but to illustrate my theory, on one of the leading railroads of this country (and I might say the one that has spent the largest amount of money in the way of scientific development of any railroad in the world), on which road we are informed the locomotives are rated by use of a dynamometer, an engine with a 20 x 24″ cylinder, 50″ diameter of driver, with 140 pounds of steam, the weight of the engine and tender loaded being 89 tons, and the rating on slow freight being 1500 tons; if we calculate the traction on 80% of the boiler pressure, it will be found that this engine is required to haul 73.9 tons for each 1,000 pounds of locomotive traction.

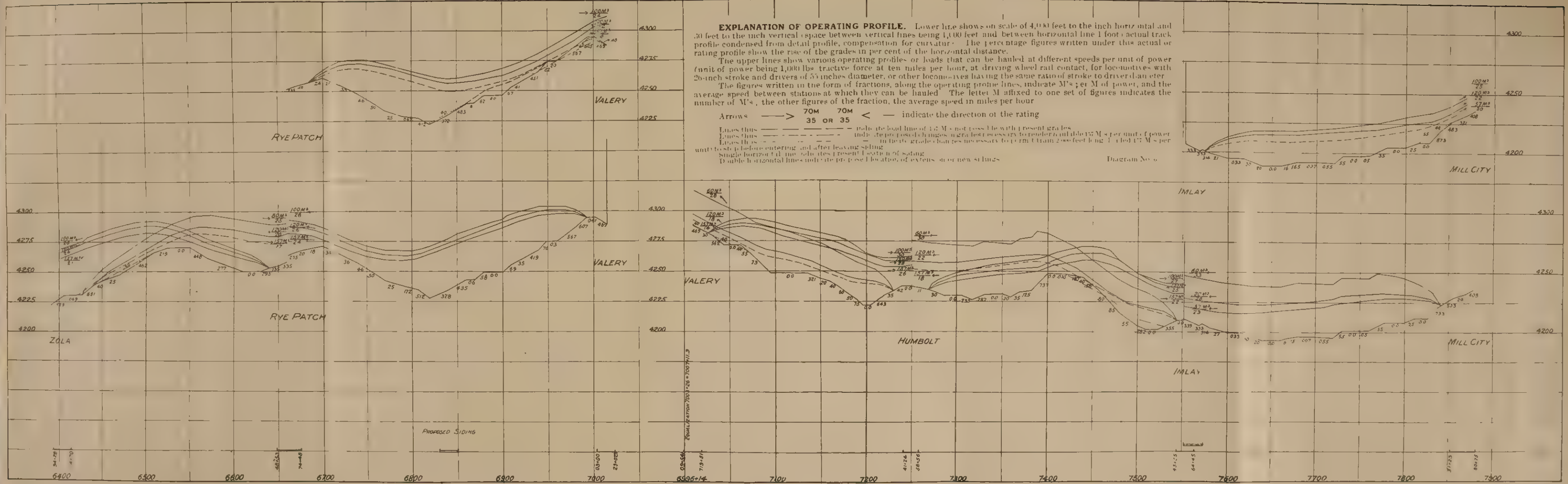
On another engine of exactly the same type, carrying 10 pounds greater steam pressure, with 10,000 pounds greater weight, the rating of the engine is 1600 tons, the load per unit of locomotive traction being 73.65 tons, and while the difference in the load per unit of power that these two engines are required to haul is immaterial, yet there seems no sound reason why the load per unit of engine traction of both of these locomotives should not be exactly the same. On this same run a new modern locomotive with 173,000 pounds on drivers, with cylinders 22 x 24 and driver diameter 56″, carrying steam pressure of 205 pounds, the traction figures 39,688 pounds, the weight of the engine and tender loaded at 195 tons, the rating of this engine is 2575 tons, showing a gross load of 2770 tons, from which it appears that this class of locomotive is required to haul only 69.76 tons for each unit of its engine traction; in other words, the older types of locomotives are required to haul 5.9% greater load for each unit of traction than the new and more modern machine.

In answer to a question as to whether the engines rated to haul 1500 and 1600 tons were taking the load on the run without difficulty, the reply was in the affirmative. If the older locomotive is able to haul 73.9 tons per unit of its traction, this would seem to prove that the new modern engine should be able to do equally as well. If this reasoning is sound, the rating of the heavier locomotive should be increased 152 tons, which is about equivalent to two carloads of freight for every trip one of these engines makes over the run.

If we analyze the ratings of the railroads generally, we will find that there is a lack of uniformity in the load per unit of power that different types of locomotives are required to haul on the same freight runs where the engines are performing identically the same service, and it would seem that there is no sound argument to advance why the newer and more modern locomotive should not be able to perform as much work with each unit of its traction as the older engines that are fast becoming obsolete.

As will be apparent from the foregoing, all that would be necessary to establish a system of locomotive engine rating on a railroad that would insure all engines being rated on a uniform basis on each freight run and that would give approximately correct results, on railroads handling mostly low grade traffic, would be by the use of diagram No. 5 in connection with the usual motive power statistics, giving the traction of the locomotives. We would first find the ruling gradient in each direction on each freight run, as before explained, and by referring to this diagram, ascertain the load in tons per 1000 lbs. of locomotive traction that could be taken at the selected speed over the limiting point, as of course the engine would be underloaded at all other points on the run, and could make more rapid speed. Then use this figure as a *rating basis* and rate engines of all types performing service on this freight run according to this


4300
4275
4250
4225
4300
4250
4200
100 M³/25
120 M³/22
157 M³/20
.408
.321
.483
.40
.55
.873
0.0
.25
0.0
.35
.05
0.0
.55
.055
.007
.165
.16
0.0
.20
.30
MILL CITY
43
42
42
42
42
430
427
425
422
420
4300
4250
4200
.408
.241
.503
.793
0.0
.25
0.0
.35
.05
0.0
.55
.055
007
.15
.16
0.0
.20
30
MILL CITY
51+23
80+75
7700
7800
7900



**EXPLANATION OF OPERATING PROFILE.** Lower line shows on scale of 4,000 feet to the inch horizontal and 30 feet to the inch vertical (space between vertical lines being 1,000 feet and between horizontal line 1 foot) actual track profile condensed from detail profile, compensation for curvature. The percentage figures written under this actual or rating profile show the rise of the grades in per cent of the horizontal distance.

The upper lines show various operating profiles or loads that can be hauled at different speeds per unit of power (unit of power being 1,000 lbs. tractive force at ten miles per hour, at driving wheel rail contact, for locomotives with 26-inch stroke and drivers of 55 inches diameter, or other locomotives having the same ratio of stroke to driver diameter.

The figures written in the form of fractions, along the operating profile lines, indicate M's per M of power, and the average speed between stations at which they can be hauled. The letter M affixed to one set of figures indicates the number of M's, the other figures of the fraction, the average speed in miles per hour.

Arrows ——> $\frac{70M}{35}$ or $\frac{70M}{35}$ <—— indicate the direction of the rating.

Lines thus ——— ——— ——— indicate load line of 157 M's not possible with present grades.
Lines thus —·—·—·— indicate proposed changes in grades necessary to render available 157 M's per unit of power.
Lines thus – – – – – indicate grade changes necessary to permit train 2000 feet long, hauled 157 M's per unit to stop before entering and after leaving siding.
Single horizontal line indicates present location of siding.
Double horizontal lines indicate proposed location of extensions or new sidings.

Diagram No. 6

*rating basis,* which would insure every one of the engines performing the same service per unit of engine traction under exactly the same conditions.

An engine rating system on this plan could be worked up for each division in a few hours in the mechanical drafting room, even though we might have eight or ten different classes of power on each division, and the only expense involved in establishing a rating system such as I have described would be the expense of the draftsman in preparing the locomotive rating sheets. However, railroads handling perishable and highly competitive freight on fast freight schedules might wish to go deeper into the subject for the purpose of determining the most economical load that could be hauled at higher speeds.

To illustrate the application of this latter principle, I beg to refer to diagram No. 6 showing an "Operating Profile" of a small portion of the Salt Lake Division of the Southern Pacific Company, which shows the equivalent grades and velocity heads attained at different points on this portion of the road. In the preparation of these operating profiles, it was assumed that the gradient percentage as offering a resistance equal to that of 1 degree of curvature was 0.04 ft. for curves up to seven degrees and 0.05 feet for curves between seven and ten degrees. This means that a ten degree curve is considered to offer as much resistance as a grade +0.5%. After plotting the track profile, making due allowance for curvature, as indicated, by reference to diagram No. 5, we can readily determine the load per unit of tractive power which can be taken, as it is a simple matter to select such a combination of equivalent grades from diagram No. 5 so that the engine shall be working to its full capacity and making its maximum speed consistent with the conditions imposed.

A very complete description of the detail gone into in the preparation of these operating profiles appears on pages 10, 11, 12, 13 and 14 of the Bulletin of the American Railway Engineering and Maintenance of Way Association for November, 1900, in a paper prepared by Mr. John D. Isaacs, Consulting Engineer of the Harriman Lines, explaining the principle of the tonnage rating system in use on the Southern Pacific Lines.

It will be noted that three velocity lines were run in each direction; the lower line is based on the maximum load that can be taken over the limiting point at a speed of ten miles per hour, but the average speed between any two points may be considerably greater than this, for example, from Rye Patch to Valery the average speed for 157 M's of load (78.5 tons) is 18 miles per hour; the middle line for 120 M's (60 tons) 22 miles per hour, and for the high speed freight line 100 M's (50 tons) 24 miles per hour. From this operating profile a table is prepared taking the highest, middle and lowest lines, interpolating the load per unit of power that can be taken at the intermediate speeds. This gives us the data for making a speed line over a freight run very similar to the preparation of a time card, for example, take Rye Patch to Valery, approximately five miles. On the low speed line of 78.5 tons per unit of power, the calculation would be 5 miles multiplied by 60 equals 300, divided by 18 (the average speed in miles per hour), and we have 16.6 minutes to be allowed on the card for the actual moving time of a locomotive, required to haul 78.5 tons per unit of engine traction. Now let us take the high speed line, and we have 5 miles multiplied by 60 equals 300, divided by 24 (the average speed in miles per hour), and we have 12.5 minutes for a locomotive loaded to 50 tons per unit of engine traction over this same 5 miles. For an engine that would be required to take the intermediate load, we have 5 miles multiplied by 60 equals 300, divided by 22 (the average speed in miles per hour), and we have 13.6 minutes, for an engine that would be loaded to take 60 tons per unit of its traction.

As will be seen, a diagram can be easily plotted, as fully outlined by Mr. Isaacs in his paper above referred to, to show the load that can be taken at varying speeds over each freight run in each direction, and from this data we get the *rating basis* (1) for slow freight train service, (2) for intermediate speeds, and (3) for high speed freight service; and every locomotive running in each class of freight service is required to take the same load laid down by the *rating basis* for each unit of its traction. As will be apparent, however, the operating profile covers the actual time of movement between stations and does not make any allowance for stops, which is a very important consideration in the preparation of freight train schedules, as the time required for stops varies on different freight runs, because of many varying local conditions, for example: the location of water tanks, telegraph offices for giving orders, the facility of getting through intermediate yards and getting in and out of terminal yards and the density of traffic. Suppose for example, we have a ten hour freight schedule on a freight run of 120 miles: if we have two trains in each direction, we would have four meeting points; if we double our service and have four trains in each direction (that meet between terminals), we have increased our train density only double, but we have multiplied our meeting points four times, therefore it is important that we should not assume any arbitrary time allowance to cover stops in the preparation of freight schedules, as the practice develops that this is a very variable quantity, varying from 25 to 30 seconds per mile run on practically level lines of light traffic density, to 2 minutes and 30 seconds per mile run on heavy ascending grade lines, the variation being controlled by the physical characteristics, the length of sidings to hold long trains, the facilities for taking coal and water, the number of stops to be made and the volume of tonnage handled in both directions on a given freight run, from which it will appear that it is quite important in formulating a scientific engine rating system that the time required for stops should be first actually determined on each freight run, and a load plotted on the proposed speed line that will consume the remainder of the card time that would be allowed for a given train between freight terminals.

*Equalization of Physical Characteristics*:

A very important consideration in connection with this system of locomotive rating is the facility with which the performance on the various divisions may be compared, regardless of their physical characteristics, for example; a rating sheet is prepared on the following lines: (See rating sheet next page.)

It will be noticed that the column next to the rating in tons is headed "Potential Ton Miles." This is arrived at by taking the net rating of a locomotive and multiplying it by the length of the freight run, this performance representing 100%. Suppose for example that an engine starts out with a full train and has quite a number of short haul cars. It is evident that this engine could not attain 100% efficiency, because part of its train would be hauled only over a portion of the distance. In the tonnage rating system usually in use, if the engine has the full tonnage at any point on the run, the engine gets a credit of 100% efficiency, but in the system herein outlined, 100% efficiency can only be attained when the engine draws the full train over the entire run. It will also be noticed that by this method of comparison, physical characteristics are equalized, for the reason that on a heavy grade line where the rating of the locomotives would be on the basis of 17 tons of load for each unit of engine traction, a perfect performance would be equivalent to 100%, while on a valley line, where the track is practically level, and where the rating would be based on 75 tons of load for each unit of engine traction, a perfect performance would likewise be 100%, and as the method of arriving at the rating of locomotives on both the hill and the valley sections is on exactly the same lines, being calculated by exactly the same formulae, a comparison on this basis is about as fair as it is possible to attain.

Therefore, if at the end of a month's work, the percentage of efficiency of the locomotives on a heavy grade line shows 90% efficiency, and on a valley line with light gradients, 90% efficiency, we know that both of these Superintendents have worked up to the same point of efficiency, based on the standard set for their respective divisions, and as this standard is calculated on exactly the same basis and from the same formulae, it would seem that the comparison is based on logical lines.

It might also be interesting to give you some tests showing how closely the actual practice checks with the theoretical calculations used in this system of tonnage rating, your particular attention being called to how closely the actual speed line checked with the theoretical speed line:

On a test made in June, 1900, from Tucson to Gila Bend, 128 miles, on a gradually descending grade for the first 80 miles, thence +0.8% grade for about 10 miles, thence dropping down for the remainder of the distance into Gila Bend; the calculated rating was 1300 tons for a "DA" ten-wheel engine with 112,000 lbs. on drivers; the calculated time line was 5 hours and 15 minutes, this time line representing the net running time, excluding stops; the actual tonnage taken was 1312 tons and the actual

Rating of Locomotives. Tucson Division. Tuscon to Lordsburg.

In M's of 1000 lbs. between tender and caboose. Rating based on using helper. See note below.

| Class Engine Nos. | Tucson to Benson Through Freight Rating | Tucson to Benson Through Freight Potential Ton Miles | Benson to Lordsburg Through Freight Rating | Benson to Lordsburg Through Freight Potential Ton Miles | Tucson to Benson Local Freight Rating | Tucson to Benson Local Freight Potential Ton Miles | Benson to Lordsburg Local Freight Rating | Benson to Lordsburg Local Freight Potential Ton Miles |
|---|---|---|---|---|---|---|---|---|
| E. D. 1440 to 1498 | 2710 | 66097 | 2010 | 116258 | 2830 | 66157 | 2710 | 156746 |
| D. A. 1808 to 1846 | 2390 | 58292 | 1910 | 110474 | 2520 | 61462 | 2520 | 145756 |
| D. X. 1847 to 1851 | 2470 | 60243 | 1970 | 113944 | 2605 | 63536 | 2605 | 150673 |
| D. I. 1694 to 1712 | 1540 | 37560 | 1220 | 70564 | 1625 | 39633 | 1625 | 93990 |
| D. J. 1726 to 1745 | 1650 | 40243 | 1310 | 75770 | 1740 | 42438 | 1740 | 100641 |
| D. L. 1684 to 1693 | 1545 | 37682 | 1225 | 70854 | 1630 | 39755 | 1630 | 94279 |
| "Helper 1" means that Helper has same power as road engine. "Helper" .75 means ¾ power of engine, etc. | Helper 1, Tucson to Mescal. | | Helper 1, San Simon to Stein's Pass. | | Helper 1, Tucson to Mescal. | | Helper 1.2, Benson to Dragoon. Helper .75, Willcox to R. R. Pass. Helper 1.2, S. Simon to S. Pass, Double S. Sub-Stat'n to Pyramid | |
| Average weather conditions. | Maximum speed at any point—35 miles per hr. | | | | Minimum speed—10 miles per hr. | | | |
| Allowance for empty and underloaded cars: Less than 40 M's...... | 3 | ............... | 3 | ............... | 3 | ............... | 3 | ............... |
| 40 to 50 M's | 0 | ............... | 0 | ............... | 0 | ............... | 0 | ............... |
| More than 50 M's | 0 | ............... | 0 | ............... | 0 | ............... | 0 | ............... |

speed line, showing the net running time of train (excluding stops) was 5 hours and 2 minutes.

Another test was made with the same class of engine from Yuma to Gila Bend, a distance of 123 miles, maximum gradient being 1%, the calculated rating being 1050 tons; the actual load 1062 tons; the calculated time line (excluding stops) being 6 hours and 13 minutes; the actual performance was 5 hours and 58 minutes.

Another test from Gila Bend to Tucson, 128 miles, with same class of engine, the calculated rating of the engine being 1180 tons, the actual net trainload being 1186 tons, the calculated time line 6 hours and 51 minutes (excluding stops) and the actual performance was exactly 7 hours.

In the following September on the Salt Lake Division a test with a mogul engine, 20 x 28 cylinders and 124,400 lbs. on drivers, from Ogden to Terrace, a distance of 124 miles, over the Promontory Mountains, the rating of the engine was 1200 tons, the actual net load 1182 tons, the calculated time line 5 hours and 28 minutes; the actual speed line made was 5 hours and 38 minutes.

Another test from Wells to Terrace on the same division where the engine rating was 1200 tons, the actual load 1193 tons, the calculated time line was 4 hours and 13 minutes, the actual performance being 4 hours and 9 minutes.

There were very many other tests made on different divisions of the road which showed equally as close a check between the actual speed line and the calculated time line; in fact as we ran along, from station to station, the actual performance checked so closely with the calculated speed line that the variation in hundreds of instances was less than one minute, from which it would appear that it is entirely practicable to calculate time lines for fast frieght trains, insuring that locomotives will be hauling the maximum tonnage at the required speed, and thereby bringing about the most economical results in freight service.

*Dynamometer Car Tests:*

Diagram No. 7 shows a resistance curve showing results obtained from a dynamometer test on the M. St. P. & S. S. M.,

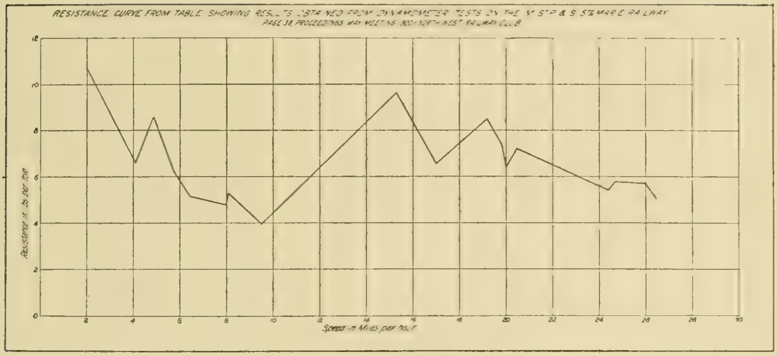


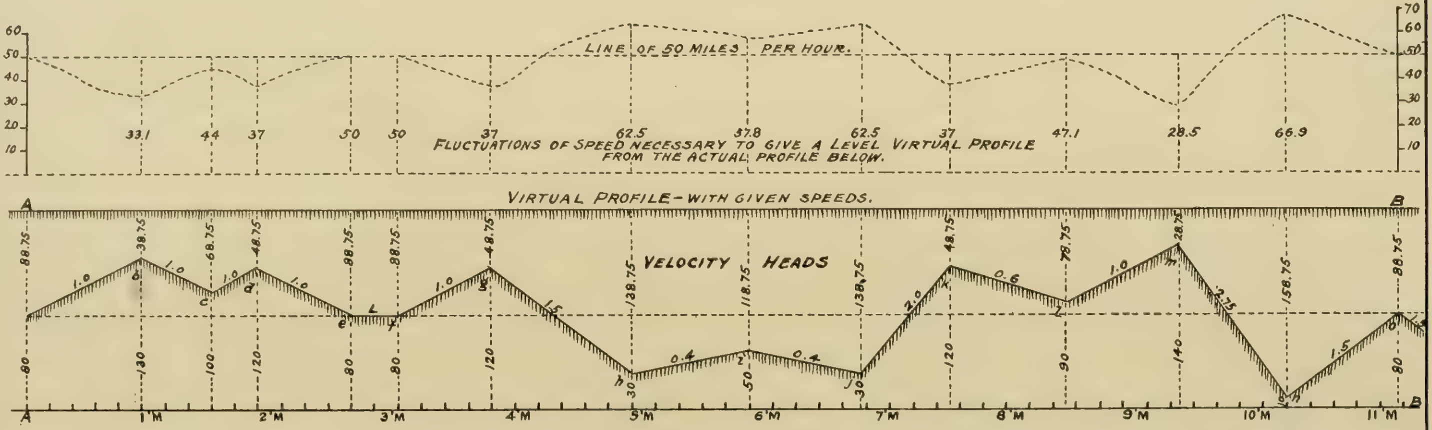
Diagram No. 7.

which no doubt shows a faithful record of the draw bar pull at the time the tests were made. As will be noted, the irregular line shown on this chart does not give a true idea of the increasing resistance to a moving load, which is always present with an increase in velocity, and it would be difficult to calculate a speed line for a freight train from such imperfect data. It is quite evident that Wellington, Angus Sinclair and other well known experts, who attempted to lay down resistance curves, based upon empirical formulae, understood this perfectly, as Wellington on pages 348 and 349, of the Theory of Railway Location, shows an undulating piece of track eleven miles long, with varying grades, as shown by diagram No. 8, which at high speeds was operated virtually as a level track, the momentum carrying the train over the short grades.

On page 349 Wellington says:

"If we had used a dynamometer record of the tension on the draw bar during such a run as this, which the writer (Wellington) has made many times over that identical piece of track at approximately the same velocities, we should find it absolutely uniform and unvarying, without any appreciable trace or evidence in the recorded strains that there were any undulations in grade or deviations from a perfect level on the stretch passed over."

This would seem to clearly demonstrate that a dynamometer test simply gives a reading at the time of the test, but it does

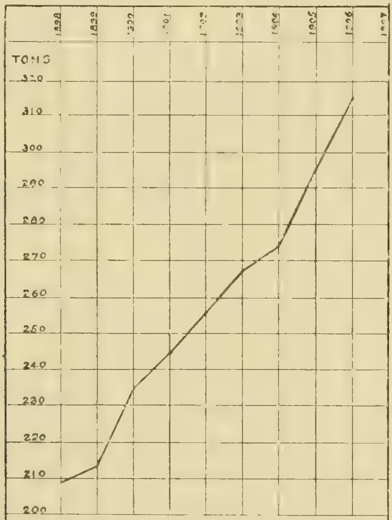


EFFECT OF VARIATIONS OF VELOCITY TO REDUCE AN UNDULATING TO A LEVEL VIRTUAL PROFILE.
THE UPPER DOTTED DIAGRAM SHOWS THE VARIATIONS OF VELOCITY.

COPIED FROM "THE ECONOMIC THEORY OF RAILWAY LOCATION" BY A.M. WELLINGTON.

Diagram No. 8.

not give the capacity of the engine, and in the use of a dynamometer, the best that we could hope for would be to make extended experiments, the same as others have done, from which we could make a resistance curve to be used in our calculations, but it is questionable whether we could evolve a resistance curve, which, in practice, would produce any better results than the curves to which I have made reference, and, in any event, the variation in any new curve that would be made, with those referred to on diagram No. 1, would unquestionably be but very slight.



COMPARATIVE STATISTICS

**SOUTHERN PACIFIC CO.,**

PACIFIC SYSTEM.

TONS OF FREIGHT PER LOCOMOTIVE MILE.

Diagram No. 9.

*Results in Practice*:

Diagram No. 9 shows the improvement in the trainload on the Southern Pacific Company on the basis of tons moved per locomotive mile, which is generally accepted as the essence of economical operation. It will be noted that there has been a marked improvement in the trainload from year to year since this tonnage rating system was introduced. It is fair to state, however, that a portion of this increase in the trainload is attributable to new modern locomotives of heavier power, yet the rating system itself has contributed largely to this very favorable result.

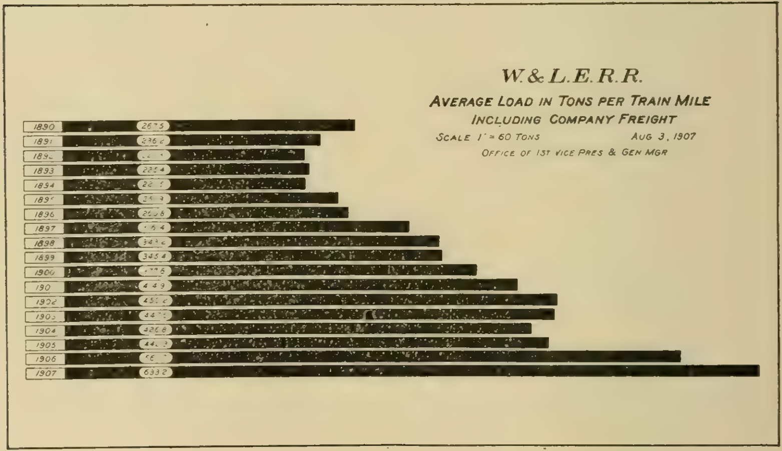


Diagram No. 10.

It will be noted by diagram No. 10 that equally as good results have been produced on the Wabash Lines East of Toledo, which shows the improvement in the trainload from the year 1890 to 1907, and would call your particular attention to the last two years since this system of tonnage rating was introduced on these lines. It should be mentioned, however, that we have not gone into the refinement of making operating profiles, but have adopted the simple and inexpensive system which is first herein mentioned.

It will also be noted that the average load in tons per train mile in 1907 was 633 tons, while for the four months' period ending October 31, 1907, it has grown to 673 tons.

*Conclusion*:

As my paper is now before you, it is probably pardonable for me to draw the conclusion, based on the practical results herein outlined, covering nearly a decade of years in freight service, that the *theory* laid down in the premises has been fully confirmed by the *practice.*

This paper would be incomplete without an apology for my presumption in utilizing the thoughts of other gentlemen and rendering due acknowledgement to the many able railroad men whose individual ideas have been worked into this system of locomotive rating. Therefore, I shall avail myself of this opportunity to tender my sincere thanks to Mr. Julius Kruttschnitt, Director, Maintenance and Operation, Harriman Lines, who was the originator of the Southern Pacific engine rating system, and whose valuable counsel and advice was frequently given during the period of its development; to Mr. John D. Isaacs, Consulting Engineer of the Harriman Lines, and to Mr. A. D'Huer, Engineer Maintenance of Way, Southern Pacific Co., these two gentlemen putting together and demonstrating the mathematical accuracy of the various formulae used; to Mr. E. H. McHenry, Vice President of the New York, New Haven and Hartford R. R., for the valuable data which he compiled from tests made with a dynamometer on the Northern Pacific to determine the difference in the resistance between empty, underloaded and loaded cars; to Mr. Arthur M. Wellington (now deceased) for the valuable data which he compiled from various tests made by him on the Lake Shore Road, and contained in his *Economic Theory of Railway Location*; to Mr. Angus Sinclair and to the *Engineering News* for the valuable data covering resistance to a moving train, deduced from tests made on the New York Central; to Messrs. H. J. Small, Superintendent Motive Power, Southern Pacific Co., F. W. Mahl, Mechanical Engineer, Colorado & Southern Ry. Co., and Howard Stillman, Engineer of Tests, Southern Pacific Co., for the valuable assistance which they rendered in working up the mean effective pressure curves and for their assistance in analyzing results in practice which did not check with formulae; and last but not least, to Mr. W. G. Curtis (now deceased), formerly Assistant to Mr. Kruttschnitt, who rendered valuable assistance to us from day to day when we were developing the system of locomotive rating herein described, my part of the work being simply the practical application of the system in freight train service.

PRESIDENT: Among those who could not be with us tonight is Mr. A. W. Gibbs, General Superintendent of Motive Power of the P. R. R., and he has embodied his thoughts in a very concise way and I will ask the Secretary to read his letter.

THE PENNSYLVANIA RAILROAD COMPANY
Office of General Superintendent Motive Power

Altoona, Pa., January 24, 1908.

Mr. J. D. Conway,
Secretary, Railway Club of Pittsburgh,
Pittsburgh, Pa.

Dear Sir:—

I regret that I cannot be in Pittsburgh this evening to hear the paper by Mr. Worthington on "Tonnage Rating of Locomotives."

Years ago, I gave this subject a great deal of attention. The idea then was to so equate the empty, light and heavily loaded cars that the locomotive would safely pull the load without danger of stalling, and some very heavy loads were handled. Later, when expedition in the movement was given greater value, it ceased to be a question of so loading the locomotives that they would just safely haul the train, but, rather, to get the most tonnage consistent with dispatch of operation. It would appear that in time of good business, successful tonnage loading is to so equate the different classes of cars and loads that locomotives of a class will attain about the same speed. In other words, it means equalization of loading; and whether this is to be to the full capacity of the locomotive or to a capacity in which some given speed will be attained, as far as possible all the locomotives should be similarly loaded so that the speed capacity of the lighter trains will not be wasted by being behind heavily loaded and consequently slower moving trains. This works out equally well for times when movement is given the preference and for dull times when the lowest expense of operation is the main object.

Thanking you for your cordial invitation, I remain,

Yours very truly,
A. W. Gibbs,
General Supt. Motive Power.

[The following communicated.]

THE NEW YORK, NEW HAVEN AND HARTFORD RAILROAD COMPANY.

Office of Vice President.

New Haven, Conn., January 30, 1908.

Mr. B. A. Worthington,
care Railway Club of Pittsburgh,
Pittsburgh, Pa.

Dear Sir:—

I beg to acknowledge receipt of your very interesting article on the Tonnage Rating of Locomotives, read before the Railway Club of Pittsburgh, for which I thank you. I have carefully read the article and derived much valuable information from its pages. I note with pleasure your acknowledgment of the information which I furnished concerning the resistance of loaded and empty cars, afforded by actual tests on the Northern Pacific Railway. Concerning this, I will add that I have gradually reached the conclusion that the tables and calculations will be greatly simplified by assuming that the resistance increases directly with the total weight of car and load, plus a constant to cover the resistances which do not vary directly with the weight. I have applied this to tests made on the Burlington and other railways and it checks out with results very closely. The actual resistance per ton varies considerably with the rolling equipment, track and roadbed, but the variations due to change of load and tare weights are fully covered by this formula.

I agree with you fully in the desirability of including the speed element in our ratings and statistics, but I very much doubt the practicability of securing any formulae for determining this which are susceptible to practical application, unless based upon the ascertained actual resistance of the division under the conditions of the schedule. By this I mean the maximum and average tractive power required per ton of train and load.

To obtain this information the use of a dynamometer will be necessary, or more simply, as indicated in my previous correspondence with you, by ascertaining the average consumption of water per indicated horse power hour by means of a meter installed upon the engine for this purpose. The division of the total water consumption by the ascertained rate thus affords a measure of the total work done in horse power hours or otherwise. The mean resistance of the division will include many factors which cannot be calculated with sufficient accuracy for practical purposes, as it will embrace curve resistance, faulty track or ballast, and above all the power lost in breaking or consumed in acceleration of the train from rest. This latter feature is very important and is usually wholly ignored, although it may account for as much as ten to twenty per cent. of the total power, and in the case of our local electric service between New York and Stamford it amounts to more than 50 per cent. of the total power consumed. This condition is occasioned by high average scheduled speed, in combination with frequent station stops.

I have also found that any attempts to ascertain curve resistance by dynamometer readings is wholly valueless unless taken during an interval of uniform speed, as otherwise the results are greatly modified by the power consumed in acceleration or released by retardation of the train.

Trusting that the foregoing may be of interest to you, I remain, Yours truly,

C. W. McHenry,
Vice President.

PRESIDENT: There is no doubt that Mr. Worthington in his capacity as Vice President and General Manager of the Wabash knows locomotive engineers on his line who are called emergency men, who can always be called upon at any hour and depended upon to get out on the line in the shortest possible time. We are fortunate as a Club in having a few of that kind of members and I am going to call on one of them tonight. When the discussion needs a "pusher" he is ready to start up on short notice under full head of steam with lots of sand and never slip a wheel. Mr. Turner.

MR. L. H. TURNER: Mr. President—I think Mr. Worthington has hardly treated us fairly. I don't see that he has left us very much to say. I was very much interested in the paper, and it has been along a line of much interest to railroad men.

As I understood the paper, his speed line was based on summer conditions.

MR. WORTHINGTON: No, based on average conditions taken from average practice; that is, the normal conditions that we found under average practice.

MR. TURNER: What is your practice in using those tables between summer and winter conditions?

MR. WORTHINGTON: In the West we do not have the extreme conditions, and do not make a reduction in our train loads on this account.

MR. TURNER: We have never been able to make a reliable rule for reduction of train loads. I sometimes think more than is necessary. There is another matter I want to ask about. You speak about average time required for stops. What allowance do you make for those delays? I have invariably found that the engines are stronger than a close calculation indicates. Possibly we made a mistake in our figures. Our engines ten years ago were rated to haul 2500 tons. About three years afterwards we decided to have some heavier ones and haul 3500 tons. We increased our cylinder capacity 40 per cent. and our boiler capacity 40 per cent. The first engines we built can today haul very easily 87 tons per unit of locomotive capacity, and the new engines can haul 93 tons with as much ease as the others haul 87.

MR. WORTHINGTON: According to our theory, the new engine on .3 per cent. grade should haul 95 tons with each 1000 lbs. of locomotive power. As there is some curvature, there must be some curve resistance, and if these engines are hauling 93 tons you are coming pretty near to perfection.

There is one thing I do not understand, which Mr. Turner might explain, that is why one class of locomotive will haul 87 tons with each 1000 lbs. of traction and another locomotive, on the same line and of almost the same type should haul 93 tons. I do not see why 1000 lbs. of traction in one of those engines is not just as good as 1000 lbs. in another.

PRESIDENT: There is a problem for some of the motive power men, and we would be glad to hear from them. The Chair would judge from the hum that this paper has excited considerable interest and discussion. Will not some of you get up and give us all the benefit of what you are saying confidentially here? I will have to call on another pusher in a minute.

MR. TURNER: Let me ask another question: What is the average expenditure of locomotive energy per ton of freight hauled?

MR. WORTHINGTON: Do you mean the rating basis? I do not understand the question.

MR. TURNER: How many pounds of traction power do you use to haul a ton of freight on an average over your line?

MR. WORTHINGTON: I hardly think I understand the purpose of your question. In fact, while I have been handling statistics for a great many years, I have never seen any figures made in this way for comparative purposes. As you understand, the number of pounds of traction that would be required to haul a ton of freight, would depend upon the physical characteristics of the particular railroad in question.

I do not criticise the performance of the engines on the P. & L. E. I think they come as near to the most economical load that the engine can haul as any railroad in the United States. I have seen your engines perform, but I do not think you have a difficult problem. You have a comparatively short line with a .3 maximum grade and hardly any curvature. In fact, you have ideal conditions and it does not require anything scientific to rate engines on the P. & L. E. Anybody can hook cars on until he can't pull any more under such conditions and find out what he can do in a very short time. The value of the tonnage rating system is on a railroad with several divisions, having varying physical characteristics, and not on an ideal railroad like the P. & L. E. where you are coming as near perfection as 93 tons is to 95.

MR. TURNER: My object was a matter of comparison to see whether you were hauling a ton of freight with less tractive power than we are.

MR. WORTHINGTON: The answer to that is this. If you will stop to reflect a minute you will see that it would be practically impossible for any other railroad to draw the same tonnage per unit of traction or get the same expenditure of locomotive energy per ton of freight hauled unless you compare with a railroad having a .3 grade and with the same conditions as Mr. Turner has, because if you had more unfavorable physical conditions, manifestly you could not do as well.

MR. TURNER: Doesn't your resistance increase in direct proportion to your grade?

MR. WORTHINGTON: It does, and that is just the reason why the answer to your question is that no other company could perform as well which did not have your ideal physical characteristics.

PRESIDENT: We have with us a gentleman who has had considerable experience along this line, Mr. Newsom.

MR. H. H. NEWSOM: Mr. President—I can assure you that I have been very much interested in this paper and in the discussion. Most of my experience in tonnage rating has been in what you might call dynamometer rating. I think perhaps a dynamometer rating is different from almost any other rating, inasmuch as it deals almost exclusively with the pull delivered to the drawbar of the tank. I have read paper after paper and outline after outline on making tonnage ratings for the last few years, since this subject has begun to be agitated, and as stated in the beginning of this paper, I do not believe there are any two systems anywheres near alike. There is undoubtedly good reason for this, as I do not believe there is any method of tonnage rating that can be applied practically to any two roads, because as just stated, the physical conditions that enter into the calculations on these different lines will make necessary an absolutely different method of tonnage rating.

In connection with the tons per thousand pounds of locomotive traction, I can say that I made a series of tests one time that were not made purposely to cover this point. However, they did develop it very nicely. With a locomotive that was 15 or 20 years old, we could pull a certain train: with another locomotive we could pull another certain train, the latter locomotive being of modern design, and I must say that in this case, with the modern locomotive, we were able to do better than with the locomotive that was 15 or 20 years old. The older one of these engines was an 18 x 24″ engine, while the modern one was a 21 x 26″ engine, and the percentage of difference between the old locomotive and the modern one, did not in any measure compare; that is the modern one did better than the old one. Perhaps in this connection, there is a point which I have often thought of, and that I do not understand, and which I have never had made clear to my mind or found a logical reason for it. With a long train you put a car of given weight on the back end, on a straight and level track, I do not see why there should be any greater resistance per ton back there, than there would be at the head end of the train, but any of us who have made tests on long and short trains, know that there *is* a difference. The only way that I can reason it out is that it is drawbar conditions which produce flange friction. If the drawbars are pulled exactly in the center of the car and in a straight line, I do not believe there would be any difference, but they do not pull in the center. They are worn unevenly or they are not cast true. If the drawbars were machined to M. C. B. standard, I do not doubt but that they might give results that we would expect, but they certainly do not do it, taking cars as they come. Perhaps there is no one piece of mechanism that enters into tonnage rating more than the dynamometer car, and I think it has been overcredited at that. The only practical use that I can find for the dynamometer car in tonnage rating is to determine whether your locomotive is doing what it should do.

Now there is a great deal of discussion as to whether you should take the best locomotive or an average locomotive for test. I do not believe that any man is able to tell what the average locomotive is on his line. There are too many factors that enter into the making of a tonnage rating, that cannot be calculated, so that I believe it is necessary to introduce into the formula for tonnage rating some constant, which covers all these little discrepancies which cannot be calculated. For instance, one engineer will get a great deal more out of an engine than another one will. The conditions that exist on a locomotive just prior to starting up a hill will change, and I do not believe any man can keep them from changing. Then there are weather conditions and wind resistance. Wind resistance can in a measure be calculated in making a tonnage rating by use of a U-tube with mercury or water. Prof. Goss' formula was derived from a series of tests made with models in a known wind velocity and it was found that the greatest resistance was on the first car, and then it would skip two or three cars and there would be a decided resistance on the next car. Then skip a few more cars until eventually the resistance was practically constant on all the cars of given size. In making a rating with different classes of engines, a method occurs to me, which I think can be worked out very satisfactorily, and in it, theory and practice agree very nicely. That is, to take a locomotive—the largest you have—and make a series of tests making a rating of that locomotive over a certain piece of track, test it thoroughly, for you must know absolutely that you have got a rating that that engine can handle on that piece of track. Then if you will take your other locomotives, one of each class and test them with the dynamometer car to find out if they are delivering what they should to the drawbar, and see how much they will pull over the same piece of track, you can make a comparison between them and get a splendid comparative tonnage rating. You will find this a very cheap rating to make. Two or three men at the most can make a very satisfactory dynamometer car test of different engines for this purpose. About all you need is one man to take the dynamometer car record, and one or two, as you see fit, to take indicator cards.

You take one side and consider the other side the same, or to be accurate, take both sides. In that way you will get exactly what the engine is doing at the cylinder and the drawbar. Also you can find what losses there are between the cylinder and the drawbar, and this is something that must be considered. Sometimes it is called internal friction, but I do not believe that that covers it, and I think the best term is to call it losses between the cylinder and drawbar. If those losses exceed a certain amount such as should be expected on that class of engine, then you had better look to the construction.

Weak valve motions, poor lubrication and any number of things may come up between the cylinder and the drawbar to reduce the tonnage. Thus there is a real practical reason for the dynamometer car in tonnage rating. I thank you!

PRESIDENT: We have not heard yet from any representative of the P. R. R. or B. & O. R. R. We would be very glad to hear from them.

MR. J. R. ALEXANDER: In connection with the very valuable suggestions brought out in the paper it might be well to comment favorably on the suggestion found on the first page, in regard to rating locomotives solely on tonnage basis. Possibly we have all had some experience where the tonnage of freight trains have been rated regardless of the required speed of the train. One of the most common reasons why we fill our repair tracks with damaged cars is the loading of trains without regard to the proper speed over controlling grades. Wherever this practice is in vogue, we almost invariably find it to be the regular practice to set off damaged cars at all available sidings over the division. I would also like to hear some discussion covering the suggestion that was brought out in the paper of a rating based on 1,000 lbs. tractive power, as compared with that method which we know of as the "adjusted tonnage" rating, which is also based on locomotive draw bar pull. This system of tonnage rating appears to me to be less complicated for the operating men who have to build up and dispatch trains from terminals, and furthermore, the latter scheme possibly makes a better method for compiling tonnage for both the short loaded or the long empty train, which have to be made up at these points and moved over the same piece of track. The necessary data is derived from actual road tests, preferably by the dynamometer car, and by the use of this plan the adjusted tonnage factor for any given grade representing the actual number of tons that can be added to the original weight of a certain train for each car the train may be decreased in length, that is, for each car taken from a certain train, a fixed amount of resistance has been subtracted from the initial resistance, which amount can be added to the resistance of a short train by simply adding a certain number of tons equal to the adjusting factor. This scheme as outlined has been used on the line with which I am connected for some years, and it appears to be one very easily handled by the operating men, and with the exception of the information contained in the paper before us this evening, we do not know anything about any other method except flat tonnage rating.

Another thing which I think counts as an important factor in getting maximum tonnage over the road is in connection with Mr. Turner's remarks having reference as to what should be the proper reduction in tonnage under different weather conditions. In this part of the country we have a great deal of that to do during winter weather seasons, and we find that some divisions have a method of arbitrarily cutting 10 per cent. from the summer rating, while others under like conditions make the predetermined figure 5 per cent. from the summer rating. In following the results obtained during the past few years, it would appear that the arbitrary reduction of 5 per cent. between the different ratings is the most satisfactory for the reason possibly of the human equation in the train dispatcher, who is responsible for the prompt movement of the train over his territory, as in many cases where he sees indications of bad weather, instructions will be hurried out authorizing a reduction of tonnage. The results are often disappointing in that the weather is not as bad as was expected, which has resulted in a greater reduction of tonnage than was necessary.

To my mind the best results are obtained where they arbitrarily make a very small difference between the different "A," "B" and "C" ratings, the train dispatcher having, of course, the authority to order a one or two unit reduction, as they may see fit.

"A" rating is made on good average summer conditions, subject preferably to the tests made by the dynamometer car and when established under these conditions is considered the "A" or summer rating. "C" and "D" rating is arbitrarily making a 5 or 10 per cent. reduction from the "A" rating and might be called the maximum rating for bad winter weather conditions, and up to within ten days ago each of our divisions were still running on "A" rating by reason of favorable weather conditions.

I do not believe it would be found satisfactory to make a predetermined figure for a reduction of tonnage based on any fixed degree of temperature, as the amount of snow and the velocity of winds has possibly more to do with determining what should be the proper tonnage for any certain period of time than the degree of temperature.

MR. HENRY F. GILG: Mr. President—A good many years ago, (nearly thirty) a long time before I ever heard of such things as "dynamometer cars," "draw-bar pulls," and the scientific calculations that enter into the traction problem today, and when I was making up the loads for the locomotive to pull, personal equation —I did not know it by that name at the time, but it has since come by experience—determined the load that was put on the engine. On the road with which I was connected, now known as the Pennsylvania Lines West, I was night dispatcher's clerk. I had to move the freight out of the yard. The summer load on the eight-wheel engine was 18 cars. The winter load was whatever we made it, depending upon the weather conditions. I knew every engineer, his ability to get over the road, the time it required him to get from one station to another, and that determined whether he was going to have eighteen cars or eighteen and an empty. About that time the freight cars run along about 10 tons capacity. And when the Wabash got out its 40,000 lbs. capacity cars, they were large, but that didn't make any difference in the load—they all got eighteen cars. If they couldn't haul them up Brigton Hill, the conductor telegraphed from Rochester or New Brighton that he had to set off a car or two, and the next fellow that went along got instructions at Rochester to pick them up.

In the winter the loads were cut down. On a night like this, for instance, they would start the engines out with sixteen cars. If they got along all right, that was the make-up for the weather conditions then existing. If they all stalled on the hill, we cut them down a car or two.

I only mention this as a matter of past experience. I recognize now, after many years in manufacturing that a machine is calculated to do a certain amount of work and it should be brought as near to its maximum as possible. In pushing your work, it is sometimes necessary to overload. Engines are built to pull a certain tonnage for each one thousand pounds of its weight, and the man who can reach the theoretical point in the work of the engine is the man who is a success. He who can get beyond that point without impairing the value of the machinery, makes the greatest success.

MR. TURNER: I would like to ask Mr. Alexander if a reduction of 10 per cent. on his train load enables the men to get over the road on an average without a drawback. In the average case can a reduction of 10 per cent. get him over the road in any kind of weather.

MR. ALEXANDER: Take two divisions for comparison, the Philadelphia and the Middle Division, last night, when the temperature was along about 15 or 20 degrees, the summer, or what is called the "A" rating, would have been an overload. The Middle Division dispatched trains on "B" rating and the Philadelphia Division also on "B" rating. Understand the Philadelphia Division "B" rating is a 10 per cent. reduction below the summer "A" rating, and the Middle Division 5 per cent. below their summer rating. The Philadelphia Division for last night had just about the right tonnage, but the Middle Division was not quite low enough, causing a slow up in the movement of freight trains over that Division. When the weather gets down to zero they may reduce the tonnage as much as 20 to 30 per cent.

MR. TURNER: Is this A, B, C and D rating made on the basis of changes in temperature or weather conditions, or is it an arbitrary rating, that for convenience is designated by these letters?

MR. ALEXANDER: I might answer that by saying that the dispatcher is responsible to the superintendent each morning for any change in the rating below the summer rating, which must be brought out by the weather conditions, strong head winds or snow along the line of his division.

MR. TURNER: As I understand it, an "A" rating would mean so many tons, a "B" rating so many tons, etc. When these ratings were laid down, were they made to correspond to weather conditions, or were they designated just as a matter of convenience?

MR. ALEXANDER: The "A" rating was established as a maximum load for summer conditions. The B, C and D rating is an arbitrarily fixed amount of reduction in tonnage to suit extreme weather conditions.

PRESIDENT: We have with us Mr. Yohe, General Manager of the Pittsburgh & Lake Erie Railroad, and we would like to hear a word from him.

MR. J. B. YOHE: I arrived too late to hear this paper read, and have had opportunity only to hastily glance over it. I think the Railway Club of Pittsburgh is to be congratulated on having a railroad man in its membership who is able to prepare and present to the Club a paper of this character.

The tests on the Lake Erie were made under the supervision of our Superintendent of Motive Power, who has already spoken on the subject, and I do not know that I can add anything to what has already been said in that direction, except to refer incidentally to the fact mentioned by Mr. Worthington of the ideal conditions that exist on the Pittsburgh & Lake Erie. I have sometimes thought that we did not deserve as much credit for the splendid showing made as is frequently given us by other railroad men, from the fact that the commodity offered us for transportation consists largely of coarse freight, such as coal, coke and iron ore, which can be satisfactorily moved in trains not requiring high speed. It is a fact, however, that our company has spent vast sums of money in reducing its grades and curves, and in the construction of four-track and double-track line so as to haul its maximum tonnage with reasonable speed and without interference with passenger traffic. Our freight locomotives are also designed to haul maximum tonnage, and by reason of these conditions we have produced some wonderful results in operation, which has been so kindly referred to by my friend, Mr. Worthington. As an old Train Dispatcher, I can endorse the remarks of the gentleman who spoke a moment ago on the question of reducing trains during cold weather simply by guess work. We have never been able to arrive at any satisfactory method of reducing our trains. As our friend, Mr. Turner, puts it, "a train dispatcher simply sticks his hand out of the window and if his fingers are made cold by the process, he returns to his chair and reduces the rating from A to B." I believe I cannot add anything to the discussion of this somewhat technical paper.

I thank you for the opportunity of adding this word of testimony.

PRESIDENT: If there are no other remarks we will be glad to have Mr. Worthington close the discussion.

MR. B. A. WORTHINGTON: There is very little left for me to say. I do not think that the fact that we cannot arrive at any accurate measure for determining the reduction that should be made because of adverse weather conditions is any sound reason why we should not have a scientific system of engine rating, because it is only a comparatively few days in the year when we have zero weather. After we establish a system of engine rating on each of the freight runs on a railroad we usually have a few men working on that particular portion of the road who have what is commonly known as "horse sense," and it does not take them very long to find out just how much they ought to cut the tonnage to keep pace with the thermometer. I do not believe it could be left in better hands than in the hands of the train dispatcher or the train master who has charge of the making up of the trains. I think, however, that the method pursued by the Pennsylvania Railroad in having A, B, C and D ratings is a good one.

One word in regard to the making of constructive allowances for empty and underloaded cars. I do not claim that our method for arriving at these results is any better than that of the P. R. R. I have talked with Mr. Crawford about their method and believe I understand it, and the truth is I like it very well. If I were introducing a system of engine rating on a road today I do not know but that I would use the P. R. R. method for making that allowance. It is extremely simple. They simply decrease the tonnage when they increase the length of the train. It works out just the same as ours. Our method of application is to make an allowance by adding additional weight to a light loaded car or to an empty car. Therefore, as I see it, the principle point is to use the system that will be most readily understood by the train men or the dispatcher in the practical application of the system.

I do not quite agree with the gentleman who preceded me in regard to rating with a dynamometer. A dynamometer will not tell anybody what a locomotive will pull; it will simply register the pull on the draw bar at the time you are making the test and under the weather conditions at that particular time. The best data that can be obtained is to make a great many tests with the dynamometer on various days, and make a resistance curve from the data gathered in this way. Of course, many roads cannot afford to have a dynamometer car, but I will venture to say that if we should today make a hundred tests, keep all the data and plot a resistance curve, marking a compositive curve from all the tests, we would get a curve that would agree very closely with the Sinclair, Wellington or the Baldwin Locomotive Works curve. If this is true, it is not necessary to have a dynamometer to rate locomotives because there is plenty of data available to give us all the information we need with which to rate locomotives under average conditions, and that is about the best we can accomplish in daily railroad practice.

I was quite interested in the remarks of the gentleman who spoke about ratings thirty years ago. I do not know that it would be anything new here to suggest that about 60 per cent. to 70 per cent. of railroads today are run on that basis.

ON MOTION a vote of thanks is tendered Mr. Worthington for his most interesting paper.

UPON MOTION—Adjourned.

# In Memoriam

## MR. ALEXANDER W. SLOCUM

In the sudden death of our fellow member, Mr. A. W. Slocum, his friends, acquaintances and business associates are conscious of a heartfelt loss.

Mr. Slocum, beloved of friends and admired by business associates, was one of those rare Characters who could impress his individuality on all who came in contact with him.

In the councils of our Club and in the discusions at our Meetings he was a leader of ability and worth.

As friends, as associates in the Iron and Steel business, as co-laborers in the Cast Iron Car Wheel Industry and its development, and as fellow members of the Railway Club of Pittsburg we are united in sincere sympathy with the family in their bereavement at his removal from our midst.

*Resolved,* That this expresion of conscious loss and human sympathy be spread on the minutes of this Club and a copy of same presented to the family.

J. W. HENDERSON,
H. J. GEARHART,
JAMES D. RHODES.
Committee.

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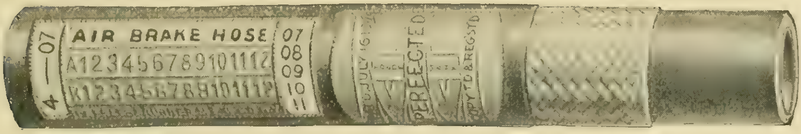

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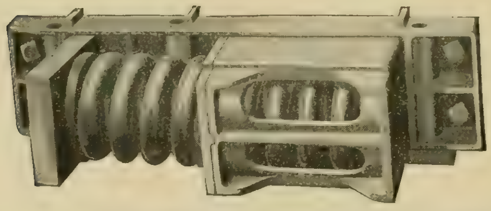

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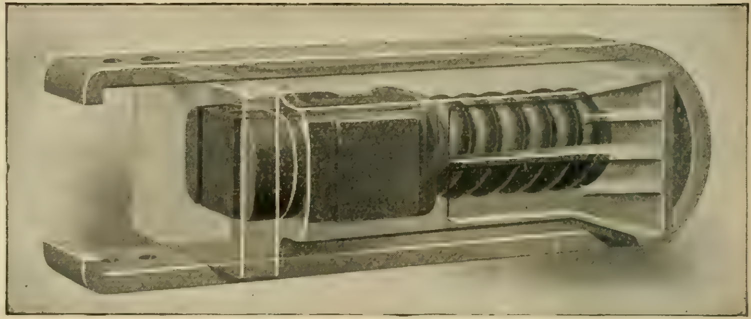

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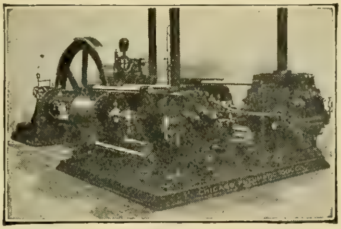

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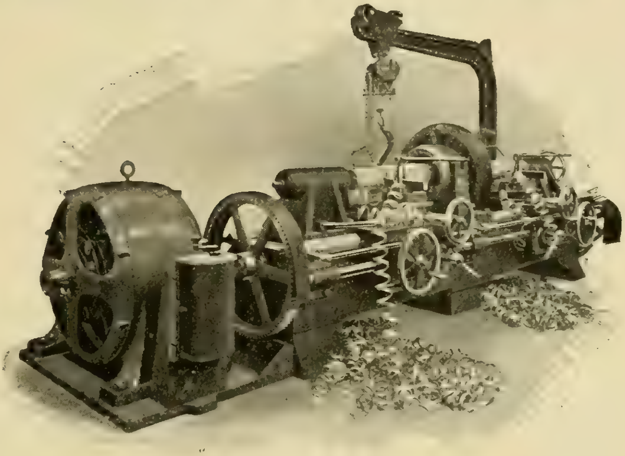

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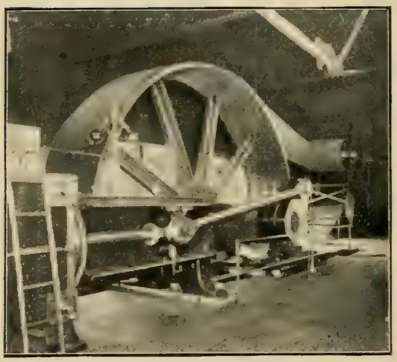

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# OFFICIAL PROCEEDINGS

*of the*

# Railway Club *of* Pittsburgh.

ORGANIZED OCTOBER 18, 1901.

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*Meetings held fourth Friday each month, except June, July and August.*

## PROCEEDINGS OF MEETING,

## FEBRUARY 28th, 1908

The meeting was called to order at the Monongahela House, Pittsburgh, Pa., at 8 o'clock P. M., with Vice-President D. J. Redding in the chair.

The following gentlemen registered:

## MEMBERS.

Alleman, C. W.
Allen, Harvey A.
Ault, C. B.
Bigham, C. G.
Bihler, L. C.
Blackall, R. H.
Blest, M. C.
Boyd, Henry W.
Brand, Thos.
Brown, E. W.
Brown, Geo. P.
Brownscombe, G. J.
Burkhard, A. A.
Burrell, J. E.
Burry, Vincent J.
Carson, G. E.
Cassidy, D. E.
Charles, John G.
Clark, Chas. H.
Conway, J. D.
Comstock, E. D.
Colburn, Wm. W.
Cole, Jewett.
Coulter, A. F.
Courson, Chas. L.
Crouch, A. W.
Cunningham, J. D.
Donovan, H. A.
Drayer, U. S.
Elder, T. W., Jr.
Falkenstein, W. H.
Gale, C. H.
Gallaher, A. H.
Gallinger, Geo. A.
Gano, J. H.
Gardner, H.
Gilg, Henry F.
Gurry, Geo.
Haring, Ellsworth.
Herrold, A. E.
Hood, D. G.
Howe, D. M.
Hughes, J. E.
Hyndman, F. T.
Irwin, E. P.
Jenny, Jacob.
Kennedy, James.
Kerr, Edward.
Kerr, Geo. M.
Kessler, D. D.
Keyser, R. H.
Kiefer, R. F.
Knickerbocker, A. C.
Koch, Felix.
Krause, Julius.
Lehr, H. W.
Lowry, R. N.
Lynn, Samuel.
Maguire, W. E.
Malloy, M. A.
Mason, E. F.
Millar, C. W.
Miller, John F.
McConnell, C. H.
McIlwain, H. M.
McIlwain, J. D.
McKee, Ira E.
McNulty, F. M.
Nagle, W. E.
Nagle, W. E., Jr.
Neely, J. L.
Nickerson, S. N.

Noble, D. C.
Oates, Geo. M.
O'Neal, J. E.
Peach, W. M.
Phelps, W. H.
Postlethwaite, C. E.
Quest, W. O.
Rader, B. H.
Randall, E. J.
Redding, D. J.
Reeve, F. J.
Ryan, W. F.
Schomberg, W. T.
Sellers, C. E.
Shaler, Fred J.
Shannon, Chas.
Smith, M. A.
Spangler, C. P.
Stafford, Sam'l G.
Stark, F. H.
Stewart, W. W.
Stuart, Malcolm D.
Stucki, A.
Suckfield, G. A.
Summers, E. W.
Squire, Willis C.
Swartz, H. E.
Tate, R. H.
Trinler, Chas. M.
Trust, J. F.
Turner, L. H.
Warnock, H. R.
Weisbrod, J. F.
Williams, H. G.
Wolf, Jos. C.
Wood, W. H.

## VISITORS.

Barth, John W.
Benton, W. H.
Borden, R. L.
Bowen, E. W.
Bower, J. G.
Clark, C. C.
Clarke, C. T.
Clark, E. B.
Deckman, E. J.
Dette, R. E.
Duncan, Wm. F.
Felton, Frank J.
Gardner, H. P.
Gray, C. B.
Grindlay, L. B.
Gorsuch, J. W.
Hallock, J. K.
Hink, Geo. L.
Kull, Will.
Kraft, H. B.
Mackenzie, P. E.
Mensch, E. M.
Morrison, C. I.
McClumpha, H. E.
Rauch, T. T.
Robertson, James F.
Ruff, J. E.
Smith, Sion B.
Smith, W. A.
Stark, Charles J.
Thatcher, Ralph H.
Walker, J. W.
Walther, G. E.
White, Arthur H.

The minutes of the last meeting being in the hands of the printer, the reading of them was dispensed with.

The Secretary read the following proposals for membership:

Dean, Albert S., Clerk, Jones & Laughlin, Woodlawn, Pa. Proposed by Chas. M. Trinler.

Deckman, E. J., Rep., Hoppes Mfg. Co., Frick Bldg., Pittsburgh, Pa. Proposed by H. V. Porter.

Finney, R., Genl. Supt., B. & O. R. R. Co., Water St. Sta., Pittsburgh, Pa. Proposed by H. W. Watts.

Geary, Chas. J., Salesman, H. W. Johns-Manville Co., 248 Main St., Pittsburgh, Pa. Proposed by E. W. Brown.

Gray, C. B., Asst. Master Mechanic, P. R. R., 32nd and Carson Sts., Pittsburgh, Pa. Proposed by M. A. Malloy.

Grindlay, L. B., Res. Inspector, N. Y., N. H. & H. Ry., 6136 Alder St., Pittsburgh, Pa. Proposed by C. H. McConnell.

Hutton, Charles A., Clerk, Traffic Dept., American Sheet & Tin Plate Co., Frick Bldg., Pittsburgh, Pa. Proposed by J. L. Neely.

Kull, W. A., C. C. to M. M., Monongahela Conn. R. R. Co., Second Ave. near Bates St., Pittsburgh, Pa. Proposed by F. M. McNulty.

Layng, F. R., Engr. of Track, Bessemer & Lake Erie R. R. Co., Greenville, Pa. Proposed by H. V. Porter.

McClumpha, H. E., Supt., National Car Wheel Co., Homestead, Pa. Proposed by J. D. Cunningham.

Rauch, T. T., Foreman Car Inspectors, Mon. Div. P. R. R., 32nd and Carson Sts., Pittsburgh, Pa. Proposed by M. A. Malloy.

Rutzky, B. E., Asst. Car Foreman, Pittsburgh Coal Co., Box 548, Coraopolis, Pa. Proposed by F. J. Reeve.

Sitterly, W. H., Genl. Car. Inspector, Penna. R. R. Co., Buffalo, N. Y. Proposed by S. M. Hindman.

Sitts, Lewis S., Rep., Jos. T. Ryerson & Son, Frick Annex, Pittsburgh, Pa. Proposed by J. D. Conway.

Smith, H. H., D. F. A., American Sheet & Tin Plate Co., Frick Bldg., Pittsburgh, Pa. Proposed by J. L. Neely.

Suhrie, Norman, Instructor of Firemen, P. R. R. Co., 2825 Penn Ave., Pittsburgh, Pa. Proposed by Jewett Cole.

Walker, J. W., Air Brake & Steam Heat Inspector, P. R. R. Co., 320 Laurel St., Swissvale, Pa. Proposed by Julius Krause.

Walther, G. C., Foreman Car Inspectors, Penna. R. R., 6391 Penn Ave. Proposed by D. E. Cassidy.

PRESIDENT: If there is no further business to come before the meeting we will listen to the paper, by Mr. Carson.

## STEEL CAR CONSTRUCTION *and* MAINTENANCE.

BY G. E. CARSON, M. C. B., P. & L. E. R. R.

Mr. President and Gentlemen:

The subject of "Steel Car Construction and Maintenance" is a very important one. I believe, at the present time, the railroad companies and the steel car manufacturers are giving this subject more consideration than in the past, and I question very much whether I can present anything new, or even suggest that which has not been contemplated by many of you.

It is needless to comment on the evolution of steel car construction, for it stands before the observant as a structure of modern accomplishments. In my opinion it has long passed the experimental stage, and is now a fixed reality to which most of us point with gratification.

Now that we are confronted with the care of this equipment, we must first give careful attention to its construction.

### *Construction.*

All sheets should be free from waves and roughness, for paint only tends to exaggerate them; giving the car an unfinished appearance. All parts should be free from flash, grease and rust before painting. In all cases when metal is placed against metal before it is riveted or concealed, the unexposed parts should be coated with a heavy paint mixture so as to exclude moisture. And during the process of construction a competent inspector should see that the riveting and bolting together of the parts are done in a substantial and workmanlike manner.

In looking at the construction of steel cars I am often led to believe that the architect sometimes forgets the necessity of designing a structure that can be repaired with economy and despatch. From a shop view, I will enumerate a few points, as follows:

Corner posts on large hopper cars should be in two sections so that it would be unnecessary to remove the entire stake in order to make repairs to the lower portion which is damaged oftener than the top portion.

Few, if any, of the heavy capacity cars have a place of sufficient strength under which jacks can be placed to raise a loaded car without damage to the car or endangering the lives of the workmen.

All one hundred thousand pound capacity cars should have four suitable places for jacking on each end of car close to the body bolsters. The construction of the less capacity cars are better in this respect.

I believe all center sills should be spliced in front of the body bolsters, as we well know that portion of the sills between the body bolsters and end sills is most subject to damage, and if spliced the damaged sections can be removed and repaired at less cost than where it is a continuous member.

Train lines should never be hung between the center sills, as they are inaccessible, either for making repairs or discovering leaky connections, and are therefore neglected by the ordinary inspector. When possible, it is preferable to have the train line and all parts of the air brake close to the outside of car, where leaks can be easily discovered and repairs made quickly.

All cars should be constructed so that it would be possible to apply a train chain to each body bolster in order to haul a defective car to the shop. There are thousands of cars now in service to which chains cannot be applied.

Drop doors on heavy capacity cars should be constructed with as little mechanism as possible, and at the same time the weight be such that a man of ordinary strength can close them, as the operating of the doors is always in the hands of the inexperienced, who often are unable physically to close some of the doors without assistance.

The floor sheets on all the cars examined are of the same thickness as the side sheets. If there is any reason for this I have not discovered it. It is recommended that the floor sheets be heavier than the side sheets, especially on gondola cars, for it is observed that the floor sheets wear and rust out long before the side sheets, and when it becomes necessary to renew the floor sheets they must be separated from the side sheets which also show signs of deterioration, especially where they join. In making repairs we cannot help but distort the rivet holes and often tear the side plates. I believe if the floor sheets were heavier the possibility of both sheets wearing out together is greater and the renewal of same would insure better results in workmanship and service.

It is also noticeable on all gondola cars that the floor sheets sag, forming pockets between the center sills, or, in fact, at any point where there is no support underneath. This, of course, is due to the deterioration of the plates or the kind of service the cars are in. During wet weather these pockets are filled with water for days at a time on account of insufficient perforation in floor sheets, which is very injurious, the only escape for the water being through evaporation.

### *Maintenance.*

The maintenance of steel cars will be a subject for debate for same time to come. I consider it not nearly as difficult a proposition under present conditions as the maintenance of wood cars.

The road with which I am connected has about 58% steel equipment, and I wish it were 100%. We do not find it difficult to take proper care of it, but, of course, it is necessary to equip your plant with a sufficient amount of machines and tools suitable for the work.

I would strongly recommend that all the work be done under cover. With the thermometer near zero it is impossible to heat and straighten repair parts and drive rivets outside, and the result is your repair plant is practically disabled. This is expensive when your equipment is needed.

Probably it might be expedient to mention a few important machines and tools which I deem it necessary to have installed in the steel car shop, coming directly under the supervision of the car department. When so installed there is no reason why all despatch work cannot be completed to your satisfaction, thereby relieving you of considerable anxiety as to whether some other department (which has all they can do to get out their own rush jobs) is going to finish yours in seasonable time that you may release your cars to-day instead of to-morrow.

A drill press is very necessary, especially when making repairs to foreign cars, in drilling carry irons, draft straps, foot board brackets, truck spring hangers or other parts which cannot be punched.

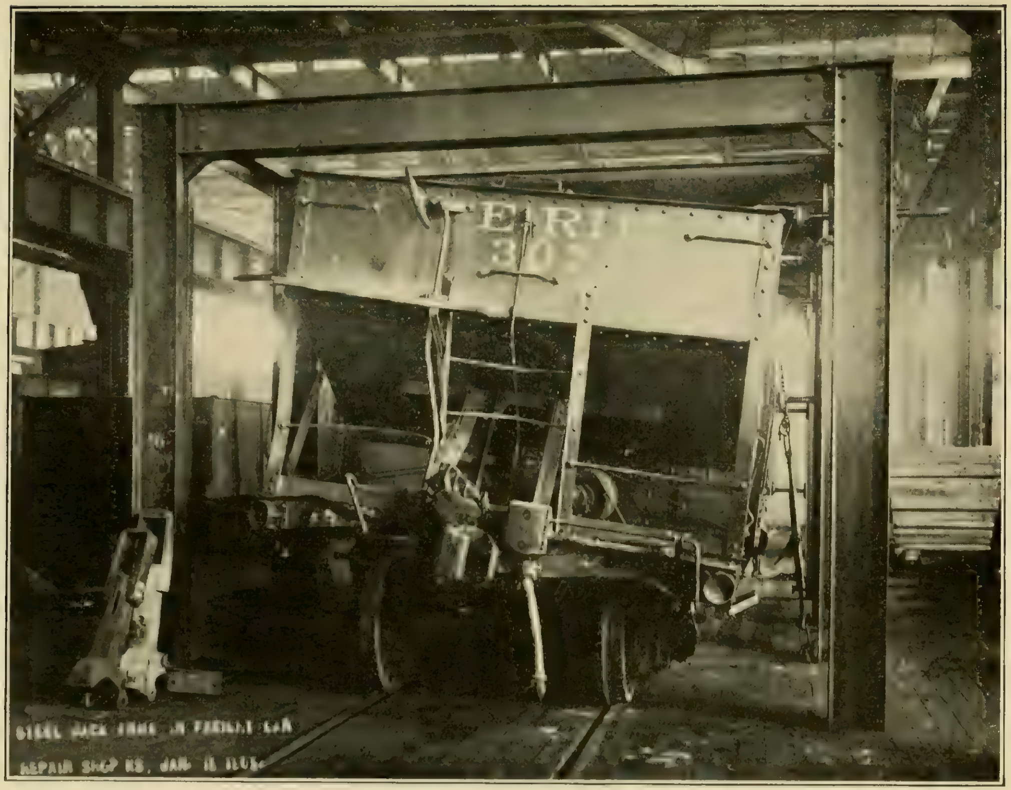
Flanging clamp for flanging floor sheets, side sheets, angles, etc.

Stationary riveter, to be used for riveting parts removed for repairs, such as drop doors, door spreaders, draft lugs, truck bolster top plates, stakes to side sheets, etc. I would suggest as much work as possible be done on the stationary riveters, for the cost per rivet is fully two-thirds less than if driven by hammer.

An air or hydraulic press, fully equipped with shapers or dies for the purpose of straightening different shaped material is very essential.

Shears, punches, angles, flat, square and round cutters are also necessary. A combination machine capable of performing all of this work can be procured in the open market, and when the shop room is limited it is very desirable.

Please note cut, which we will term a steel car pen. This is not an expensive device, and is certainly a paying investment. It can be used to the very best advantage for jacking back cars into shape while cold, which have been twisted or bulged by accident. I recall many cases where this device has saved thirty to


ERIE
30
STEEL JACK FRAME IN FREIGHT CAR
REPAIR SHOP JAN. 11

fifty dollars labor per car. Of course, this structure is not intended for use in all classes of repairs.

A good sized Heating Furnace is another necessity and it should be sufficiently adequate to admit the largest car sheet and to accommodate about five thousand pounds of various kinds of plates, end sills, etc. A furnace with inside dimensions 2′ 4″ x 8′ x 13′ will accommodate this amount of material. By keeping in stock a sufficient amount of new standard material it will not be necessary to keep the furnace in constant blast. I have worked very successfully by using new material to replace damaged parts, allowing the damaged parts to accumulate until there was a sufficient amount on hand to justify heating the furnace, and find it more economical to manage it this way. All material which is straightened or repaired is reserved in stock to be used on the next cars that come in.

In front of the furnace an iron working plate about 5½″ x 3′ 3″ x 10′ should be stationed with the necessary clamps for holding the bent parts in place while they are being straightened.

In every steel car shop where there is sufficient work to warrant it, there should be an overhead crane for lifting the cars up on trestles instead of jacking, which can also be used for placing and retaining the plates until secured by the workmen. By using a crane a couple of men on the ground will handle the largest plates used, otherwise a scaffold and a number of men are necessary to raise a plate and fasten it, accompanied by more or less danger to the men.

When equipped as outlined, I have found that on the heaviest of steel car repairs two men are able to handle most of the repairs, but find it practicable to place a gang of six men on three cars and by dividing them into three gangs they can do their own cutting apart, fitting up and riveting, and not be detained by material, which in the meantime is being straightened or machined. I have operated separate gangs to cut apart, fit up, and rivet, but with little success, for it is immaterial to the men who cut apart as to what becomes of the parts removed, and the gangs following lose considerable time in locating the parts when needed.

It is also practicable to have stationary rivet heating furnaces in the car shop, placed so that each furnace can supply rivets to three gangs of six men each.

Painting of steel cars is of the utmost importance, and where we have a great number of them, the repainting process is continuous.

Therefore, recommend a suitable freight car paint shop, for the painting cannot be done outside in inclement weather. When your equipment needs painting you cannot afford to neglect it until favorable weather comes. As a rule, in the summer months the equipment is busy, and there is little opportunity to withdraw it from service, except in cases of extreme emergency. Newly built cars, when ready for first painting, should have all the flash and rust removed. Unless this is done the flash and paint will continue to fall off in spots as long as any flash remains. In order to remove the flash thoroughly I would recommend the sand blast process. When it is not possible to use this method, would suggest the dry cleaning process, by using steel scratch brushes, sand stone, or any tool which will answer the purpose, which is not so satisfactory. Following either process would suggest the application of three coats of paint at twenty-four hour intervals. Later on, when repainting is necessary, I again recommend the sand blast. If this cannot be done, dry clean, and apply two coats of good paint. After taking these precautions to protect the exterior, we learn from experience that under ordinary conditions it is necessary to repaint at the expiration of about three years, and where conditions are unfavorable to the equipment, the repainting should be governed accordingly. I cannot be too emphatic as to the necessity of taking the proper care of the exterior, and regret that the interior cannot receive the same attention, but by spraying the interior with crude oil occasionally, it may be found beneficial as a preservative.

At the present time the P. & L. E. R. R. are testing this idea, and I am very sorry the test is not completed so as to enable me to give you the results.

The best of paint should be used in order to prevent rust after painting. The paint which has the greatest wearing elasticity is preferable, as there is less liability for the penetration of moisture. Adhesion is just as important, and to have perfect adhesion the paint should dry from the inside out, the same as good varnish. By using the best materials we need not fear the expansion and contraction of the plates as long as the elasticity remains.

Following is some data showing the relative cost of repairs to steel and wood cars, which I am confident is correct so far as it pertains to the P. & L. E. equipment repaired on its lines:

100 Wood Cars requiring heavy repairs:

| | | | |
|---|---|---|---|
| Cost of material | $2521.00 | Average per car | $25.21 |
| Labor and supervision | 1631.00 | " " " | 16.31 |
| Total | $4152.00 | Total | $41.52 |

100 Steel Cars requiring heavy repairs:

| | | | |
|---|---|---|---|
| Cost of material | $3424.00 | Average per car | $34.24 |
| Labor and supervision | 2292.00 | " " " | 22.92 |
| Total | $5716.00 | Total | $57.16 |

I wish to mention further that a very accurate record was kept of the average number of times the different classes of cars were called into the shop for light, medium, and heavy repairs, covering a period of one year, as follows:

| | |
|---|---|
| Average number of times one wood coal car was in shop during one year | 7 times |
| Average cost of repairs each time in shop | $16.23 |
| Average number of times one wood coke car was in shop during one year | 6 times |
| Average cost of repairs each time in shop | $10.74 |
| Average number of times one steel car was in shop during one year | 1⅓ times |
| Average cost of repairs each time in shop | $6.74 |

The above figures represent the cost of material and labor less scrap credits, and is the average cost of the total repairs to

| | | | | |
|---|---|---|---|---|
| 806 | Heavy | steel | car | repairs, |
| 1352 | Medium | " | " | " |
| 9180 | Light | " | " | " |
| 11338 | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 707 | Heavy | wood | coal | car | repairs, |
| 513 | " | " | coke | " | " |
| 3018 | Medium | " | coal | " | " |
| 3354 | " | " | coke | " | " |
| 12438 | Light | " | coal | " | " |
| 12040 | " | " | coke | " | " |
| 32070 | | | | | |

Your attention is called particularly to the number of times a steel and a wood car is called into the shop per year, and to the difference in the cost of maintenance per car. Of course, it must be understood that when the time comes to renew the steel car parts which are worn out, the figures shown will be inadequate for the reason that we are comparing steel cars with a collection of new and old wood cars, but even so, I believe, if we give the steel cars the proper care their maintenance will be less in the end than that of wood cars.

PRESIDENT: The question is now before you for discussion, and I will call upon Mr. Stark to open the discussion.

MR. F. H. STARK: Mr. President—I feel that the subject is one of vital importance to the railways, especially in the Pittsburg district. I know of no man so well qualified to present this subject as the author of the paper. It has been his privilege to be located right where the steel car was born, and with his personal bent for investigation he has thereby been enabled to glean valuable data that the ordinary steel car designer does not have the opportunity to get.

We all understand how the steel car was first launched on the railroad world. The railroad men were slow. I can remember the first all steel car which came under my observation. It was on the Lake Shore possibly 30 years ago. These cars were operated as powder cars, and I presume the reason they were not introduced generally at that time was on account of the expense of wrought iron. Mr. John Kirby, for many years Master Car Builder of the Lake Shore, introduced the first metal truck bolster, which outlived some two or three bodies. Years elapsed before Mr. Schoen placed on the market his ready made cars. He first had the center plate, the corner bands and the stake pockets, and then the ready made cars were presented. Unfortunately the railroad mechanical men were not taken into their confidence, and naturally there were a great many weak points in the original steel car, and no one will ever know what it has cost the railroads to develop this forced hot house plant. However, the car designers have acquired information and there is a wonderful improvement.

I presume in the early stages the question of carrying capacity in proportion to dead weight was considered too seriously. It was one of the advertisements of the steel car that it could carry a greater porportion of load than a composite car. Then, too, the question of first cost had its bearing. All this had a tendency to place on the market cars of lighter weight. The P. R. R. first designed and commenced building heavier cars. It is essential that a sufficient amount of metal shall be embodied in the construction of a steel car to carry the load without any permanent deflection. The car sides should act as a girder and maintain a vertical relation to the body. I think, as Mr. Carson says, that the center sill should be spliced ahead of the body bolster. In ordinary car construction the center sill should be continuous and not be cut off at the body bolster. There are some special cases where cars of large capacity are required where it would be almost impossible to maintain a side bearing clearance, when perhaps it would be advisable to have the body bolster continuous and secure the draft sills ahead of the bolster.

I am glad to notice that in the later designs of steel cars they are turning the flanges at the lower edge of the side center sill inward rather than outward. That adds to the appearance and prevents the sides from being bulged in. I believe the car dump designer will have to take into consideration the construction of the steel car, for there is a great deal of damage done to cars while being operated over the car dump machines.

I believe with Mr. Carson that the cars should be painted.

There is no question that the steel car is here to stay, and it will be an advantage to the railroads to have all steel cars, for wooden cars in between steel cars will not stand the service.

PRESIDENT: Inasmuch as these two men have had a good deal to say about the weak points of the car as constructed, perhaps some representative of the steel car manufacturers might have a word or two to add in defense. Can we hear from Mr. Postlethwaite?

MR. C. E. POSTLETHWAITE: Mr. Stark's point that the early design was not, perhaps, what it ought to be, is a little on the order of a story which I heard in a New York theater about the Jamestown Exposition. One actor asked another, "Have you been to the Jamestown Exposition?" "No." "Well, somebody has got to go." So it was with the steel car; somebody had to start it somehow, and many of the railroad men in those days were afraid of it. They said it would not last and would give too much trouble in repairs, and they had no facilities for such repairs. (Railroad men with such views have now disappeared.) Consequently, the design was launched by the car company—and it was a good design at that.

At first it was the disposition of railroads to allow the steel car to be put in a freight train indiscriminately, along with wooden cars, but with increased numbers of steel cars, when a wooden car was between two lots of steel cars, there was often trouble, and this led to an effort on the part of many railroads to have wooden cars kept as nearly as possible in solid blocks in the rear of freight trains, until today the steel car has so thoroughly demonstrated its office as a money-maker and money-saver for railroads, that practically none of the larger railroads order anything but all-steel or a steel underframe car in replacing their equipment.

During the past ten years tonnage per train-load has been greatly increased, and this increased tonnage has made it necessary to strengthen draft rigging, center sills, etc., to withstand the shocks that come from handling. We all know there is no disposition on the part of yardmen to handle any freight car gently, but when it comes to a steel car there is a feeling among yardmen that it will stand anything.

As Mr. Carson was giving some figures, I noted those covering heavy repairs to steel cars. Had those cars been of wood instead of steel, there would have been nothing left to repair. In the case of a steel car, there is always something to work on, and the railroads are just that much ahead.

We are beginning to get some real figures on our own cars which have been in operation for a number of years, and we find that steel cars, as against wooden cars, cost from one-third to one-quarter as much to repair, at the end of four or five years, and that while it costs more each year to keep up a wooden car, the increase each year in the keep-up of a steel car is comparatively little. Steel cars might be considered arithmetical progression and wooden cars, geometrical progression, as the cost diverges very materially as the cars get older.

I had the experience of dealing with some Frenchmen who were in this country about 1901 to buy steel cars. The Frenchmen asked me how long we figured the steel cars would last. It was in the early days and steel cars had been in service in this country but a very few years; I stated that I thought they would last at least 20 years. Their answer was quite emphatic that they thought I was wrong, for they had in France some iron cars that had been in service between 30 and 40 years and they were still doing business. I was on the easy side of that argument. But the life of the steel car is yet a question to be determined. Considering the thousands and thousands of steel cars that have been manufactured, and the actual number completely destroyed, the figures are surprising and amount to practically nothing.

Take the matter of design: the manufacturer is not always able to control that. The mechanical experts of different railroads have their own ideas, and they expect car builders to follow them. We car builders have the experience of what is good and what is bad in both the early designs of our own and the late designs, and the tendency is today to produce heavier cars and much stronger cars than originally.

The question of maintenance and repairs to steel cars has been discussed by other railway clubs. The New York Railway Club in their proceedings of February, 1902, show some very interesting data; and the New England Railway Club proceedings of October, 1906, has a very interesting discussion. So there is really very little new to add to what has been said. As to designs, we have been in the business from the start, and the sum of it all is a good deal like looking over a stock-farm; you can see the "has-been's," the "is-ers" and the "to-be's" of steel car designs.

PRESIDENT: I think there are some other steel car men here from whom we might hear. Mr. Stucki?

MR. A. STUCKI: Several years ago I was called upon to examine a steel hopper car which was used in construction work and which was badly smashed up. A big rock fell upon it and bent and twisted one-half of it entirely out of shape, while the other half remained almost intact. The railroad at that time was not yet prepared to undertake such heavy repairs, and therefore asked the car company for an estimate

We had a very clever repair foreman who at that time had quite a job on hand to repair a lot of cars of one of the first designs which showed weakness in the service. He knew how to use the straightening table and the maul. He had special and powerful tongues, by which he lined up the flanges of the sheets. We also used screw-jacks and screw spreaders in connection with portable heaters, so that distorted parts often could be brought back without dismanteling the details.

Bearing all this in mind, I estimated the cost of repairs for the above car $135.00, covering not only the labor, but also a new side sheet and a new coat of paint. The foreman, however, made use of the old sheet and put a patch on the torn corner. This way the railroad company obtained a car, approximately worth $1000 for a comparatively small consideration, while, had it been a wooden car, there would have been nothing left of it, as Mr. Postlethwaite said before.

As to the thickness of sheets, there are many cases where the side sheets should be at least as heavy as those of the floor, inasmuch as they, besides confining the load, are also needed to give carrying strength to the car. This is especially true in case of gondola cars.

A spliced corner post I have not seen as yet, and I think the idea is novel and worth careful consideration, while the up-to-date steel cars now usually have a place for jacking. This is mostly accomplished by having a solid extension of the body bolster or by having fillers between the flanges of the side sills, so as to prevent the crushing of the same.

The life of a steel car depends entirely on the conditions of the service. The 40 years mentioned tonight relates to French practice, not American practice. Dropping cars down the humps with defective brakes, running into each other at high speeds, compelling them to run in trains with blistered sheets like sick soldiers marching in the army, all this will help to shorten the life beyond what can be expected if the cars are reasonably handled and maintained.

PRESIDENT: I see Mr. Bowen in the room, we would like to hear from him.

MR. E. W. BOWEN: I have not had any experience particularly with steel cars until I came here from the west to look after some steel cars our company is having built, and I came up here tonight to listen. These are practically our first cars of this kind, so we do not know how they will stand up under our service conditions.

PRESIDENT: Mr. Stucki said it was necessary to have heavy sides on the cars to help support the weight. I believe Mr. Summers might give us some light along that line.

MR. E. W. SUMMERS: Mr. President and Gentlemen—A number of years ago I had something to do with the design of car dumping machines, in fact, I had considerable to do with the first successful side dumping machines. Some of the first cars operated over one of them were made with gas pipe in the side sills for top and bottom members and had the stakes attached to these pipes by clips. This car dumping machine had clamping chains held by counterweights, and as the car turned over, it was simply wrapped in these chains to keep it from falling out of the machine. The effect of the chains on the gas pipe cars was to fold down the sides something like a shoe box that has been stepped on.

At that time there were few steel cars in use, possibly two or three; but none of them got into the dumping machine. The effect of the chains on the wooden cars was to rip down the sides, sometimes clear to the floor line.

Of course, the machine had to take all kinds of cars to dump—big and little, long and short—some with heavy side stakes and some with none at all; and in turning over the car the lading would run out of the space between the stakes and the apron side of the car dumper, so that some of the load was lost through the machine. In order to take and hold all forms of cars on the dumper, we had to supply beams at intervals along the apron side of the machine, which beams contacted the side of the car when it was moved over to the apron in the operation of dumping. These beams were necessary on account of obstructions on the sides of the cars. To prevent crushing in the top of the car sides, the chain clamping device was changed to a beam across the top to hold the car in the machine when it is turned upside-down. The effect of this was to throw all of the weight of the car on to the side girders and to concentrate the pressure in spots on the top flange.

From these experiences in operating car dumping machines, and other engineering experience with cars, I had come to the conclusion that the deep sides of a car are well adapted to carry the load. But no girder is efficient without a top flange compression member wide enough to give it the proper stiffness to prevent buckling sideways. That is a defect in a great many designs of steel cars; but it is a defect that is being corrected. A number of cars built recently, with a channel riveted on top of an angle or the side sheet turned over, show that this feature is beginning to receive attention. A good top flange strengthens the side girder and helps it out to such an extent that it practically carries all of the load, which is the natural construction owing to its depth and position in the car.

The question of repairing cars has been spoken of, and while it is thought that the design should be such that the parts affected most in wrecks should be spliced in the beginning so that they can be easily removed, I have often wondered without having the exact knowledge, what percentage of the cars in service have to go through these repairs. To splice a draft sill or a corner stake costs something. A splice on a corner stake would require at least 12″ for either a butt splice or to lap one angle over the other. This would necessitate driving a number of additional rivets, all of which enters into the first cost of the car. It is probable that the first cost saved by leaving out the splice would create a fund, the interest on which would cover the cost of all of the repairs of this nature, especially when we consider the statements that the repairs on steel cars do not amount to much. Undoubtedly, breaks do occur at difficult places to repair on the cars. For instance, a crushed draft sill that passes through the bolster may necessitate taking out the bolster, which, of course, runs up the cost of repairs when it occurs, and such conditions may warrant splicing all of the sills as an item of the first cost.

Engineers of car design, seem to me, to be losing sight of the fact that if the draft sill is backed up by a stone wall (or its equivalent) running against it with a car crushes it much more easily than it would if the backing up were of a flexible construction. Increasing the cross-section of the straight line column from end to end of the car, to overcome breakage of draft sills, has been going on from time to time until the center sills in recent cars are so massive that they represent a stone wall or an unyielding backing; and, this, in my opinion, is the cause of the large number of failures in the draft sills proper. I have expressed this opinion here before, and supporting it are cars of my designs in service for a number of years which are without center sills at all (utilizing the elasticity of the car as backing) and the repairs on draft sills in these cars has been "nil."

Car designers should give more attention to securing greater flexibility back of the draft still construction, to withstand the shocks; especially when it can be done cheaply for first cost and prevent draft sill repairs.

PRESIDENT: Mr. Krause, we would like to hear from you.

MR. JULIUS KRAUSE: Mr. President—I do not wish to make any remarks which would hurt Mr. Carson's feelings, as we inspected cars together in our younger days, but I cannot agree with him in all he said tonight. The cost of repairs to steel cars is too low, as it would not pay for the wheels used under steel cars. While I admit the cost of maintaining wooden cars is high, we must not forget that the wooden cars referred to are from 15 to 20 years old and the steel cars from one to ten years old.

I believe it would be wrong to increase the floor of steel cars to one-half inch thick, as this would add 4,000 pounds of weight to the car, which would make it expensive from a transportation point of view. I believe that steel cars will become 25 years old before they are worn out and that the floor will wear out in about one-half that time, but floors are so constructed that they will not be difficult to renew.

The matter of painting steel cars is a serious question, as the paint on the inside of the car, especially self-cleaning cars, will not remain, and on the outside the paint also receives very rough usage at unloading points, sides of the cars being pounded by mauls and sledges, in order to unload them in the shortest time.

Mr. Postlethwaite states that repairs to steel cars are not expensive. I agree with him that the steel car is a superior car, and will take the place of the wooden car, but we will find that the repairs to steel cars for the first ten years of its life will be very much less than the last ten years of its life. We find when cars become eight to ten years old and are wrecked and parts bent and broken, that some parts that were ¼ inch thick when built that one-half of this thickness has been consumed by rust and cannot be straightened but must be renewed, which makes the repairs more costly. I have reports of forty steel cars being sent to the shop during the last twenty-eight days on account of the center sills being broken back of the body bolster. These cars belong to a lot of 4,000 that Mr. Postlethwaite built six years ago, and are considered standard cars equipped with friction draft gear, so you must agree that keeping steel cars in repairs is not going to be all sunshine.

MR. G. E. CARSON: I am still not convinced with reference to the floor sheets. After the floor sheets are worn out at the point where the floor is joined to the side sheets, we have found more or less deterioration on the side sheets, and when cutting away the floor we distort the rivet holes in the side sheets, and in applying new floor sheets do not consider it good practice to rivet a new plate to one which is about half worn out. For this reason I still contend that if the floor sheets were a little heavier there would be a possibility of the floor and side sheets wearing out at the same time, and when renewing same the work could be done in a more substantial and workmanlike manner.

With reference to the figures showing the cost. I previously stated that when the time comes to renew worn out parts of steel cars these figures will be inadequate, but wish to say that 58% of the P. & L. E.'s equipment is steel and aside from the light running repairs we are taking care of the steel equipment with about 50 men, and have about 300 men on the wood portion of the equipment.

I believe the oiling on the inside of steel cars is a thought in the right direction and deserves trial, but would not recommend the removal of corrosion. Corrosion is principally made up of foreign matter and there is very little deterioration takes place under this corrosion, therefore do not consider that it is necessary for the oil to penetrate the corrosion, but sufficient oil used to cover the exposed parts.

MR. F. H. STARK: I believe we are allowed to speak not more than twice, so our friend Krause is done. Usually he takes advantage of the situation and imposes on the little fellow. But this time I hardly know how to make the application. The Irishman says, "Hurrah for Ireland." The Yankee says, "Hurrah for hell!" And the Irishman says, "That's right, everybody for his own country." Here we have two fellows from the same country opposing each other. I might account for the trouble Mr. Krause had in this way. It is the elements out of the coal that corrode the steel, and they hold their cars under load so long and move them so slowly that the corrosive elements have a long time to work on the steel.

Now Mr. Carson has said that his wooden cars came into the shop seven times a year and it cost $16 for repairs. I wonder whether he meant seven times a year for each car, for every wooden car that he had?

MR. CARSON: Yes, sir.

MR. STARK: That is more than I would expect. We have with us tonight the superintendent of the steel car department of the Pennsylvania at Altoona and we ought to hear from him. We have tried for three or four years to get a Pennsylvania man to tell us something on steel car repairs. They have a modern plant down there where they can take a car that is all distorted and put it into shape in an hour and a half, and they have never invited us down there to see it. The P. & L. E. have a modern plant and I want to compliment the P. & L. E. for giving us the benefit of it. If the Pennsylvania, through their superintendent at Altoona, will give us the benefit of their experience we will forgive them for the past.

MR. H. B. KRAFT: The gentleman is mistaken about the superintendent, it is only the foreman.

PRESIDENT: Foremen sometimes can give more information that the superintendents.

MR. H. B. KRAFT: We have a very modern plant in Altoona. We turn out anywhere from seven to twenty cars per day. We can tear a steel car down completely and rebuild it again in from four to five days. For splicing sills we turn the car upside down to cut off and splice, which we find to be the most economical way. We have the first cars to find in which the sills could be spliced in front of the body bolsters; in all cases we find them to be weak about 10 inches back of the bolsters. In splicing sills at this point it is necessary to remove and replace the bolster, which runs the expense up considerable; however, there seems to be no way of overcoming this. As to floor sheets we find quite a number worn pretty near through after the cars have been in service only two or three years. Only the other day an inspector in looking over a car didn't see any holes at all, but in making a close examination he stepped on one and his foot went clear through. This, I think, comes from the sulphur eating through as well as the rust which is being continually knocked off at coal tipples when loading, the coal being dropped anywhere from ten to twelve feet. In regard to the replacing of these sheets, we have not as yet found a car where it was necessary to take out a side sheet in order to replace the hopper sheets. The flange on the hopper sheet protects the side from the coal sliding out. I have not yet found one side sheet that was only ⅛ inch thick. I will give you gentlemen all an invitation to visit the Altoona Shops and will be only too glad to give you any information I can. I did not know that I would be called on to talk or I would have made some preparations. I only found out this morning at 10 o'clock of this meeting, and I came over to hear what the other people had to say.

MR. E. W. SUMMERS: Mr. Carson's side partner has made one statement that I cannot understand. He speaks about a lot of self-cleaning cars handling coal, but he says they send down prize fighters with mauls and bars to pound them all around.

CHAIR: That is probably because they have those prize fighters and they have to make use of them.

MR. POSTLETHWAITE: I think the question is easily answered. The lumps in the coal clog. I have seen it often. And in cold weather if the whole bottom of the car were to drop out when the coal freezes you have to loosen it somehow before it will drop.

It was my pleasure to enter the service of the car company just a few months after the first steel car was launched in Pittsburgh, in 1897, and from that time until a year or two ago the experience was on the order of a pyrotechnical display on the Fourth of July. One of the things we had first was a rush message from a railroad that their "hoppers were bulging." We could not understand why they were bulging; we sent a man out, and in the steel mills where the ore was frozen they just put a little dynamite in to loosen it. Another thing, a road not very far from here got 1000 gondolas without drop bottoms, the first ones of the kind we built. A few of those cars had been loaded with coal and they had been put in on the side-track; a teamster was busy unloading the coal, and a heavy rainstorm came up and the cars filled with water. The teamster went back and they waited for the water to run out of the cars, but it did not run. We got a telegram, "Your cars are holding water, what shall we do"? Our answer was, "Bore drain holes in them and we will bore drain holes in the rest of them." These are just two of the experiences we have had. If anyone would like a hundred or two more, let them come around.

In connection with the discussion as to thickness of the floor, I would like to ask what is the purpose of a steel car or freight car of any kind? We as manufacturers have always understood that it was for the transportation of coal or other commodity. We all know the disposition of railroads to stand cars on sidings and let them stand there for months, and coal that is highly charged with sulphur is bound to affect the car in the end. Isn't it a fact that when you abuse the use of anything, you do not get the best possible results? If cars are used for storage, all right, but then don't kick about holes coming into the floor.

Referring to the splicing of center sills in front of the bolster: We have railroad patrons that would not have a car with the center sills spliced, and there are others who would not have them unless they were spliced. So there you are!

Another point that ought to be considered in the cost of maintenance of a steel car, as compared with a wooden car, is the utility of the one as compared with the other. When the class of long gondola car, known on the Pennsylvania as the "G. R.," was built, it was one of the most expensive and heaviest freight cars that car companies had built up to that time, but when these cars first went to the steel mills, one car took a load for which it required four of the old style gondola cars to move. In other words, it was long material and they had to use twin cars with the old style car.

MR. HENRY GILG: I must say that I have been very much surprised to learn that the question is not yet settled of the economy of the steel car. I remember a generation ago that it was decided most positively that the metal car never would be a success. I saw some of the cars that Mr. Stucki had reference to, so far back that it seems to be a dream, 1868 or '69. I believe I saw a passenger car on the Fort Wayne that was a metal car. Afterwards when I was a clerk on the Ft. Wayne I inquired of some of the men why the iron car was not used instead of the wooden one, and I was informed with a suitable amount of expressiveness that in wrecks they were a total loss, as they could not be repaired economically.

Not having had experience in designing or building steel cars, I cannot make any suggestions, except from the side of the man who comes in contact with them, that is in reference to painting, particularly the numbers. Last summer I went with the scale clerk to the scale—he was about to weigh a car and could not make out what it was. The conductor gave me the number. How he knew it I don't know. But it has occurred to me that some suitable number plate should be placed upon the car and kept in better condition so that a man in the transportation department will be able to determine the number without loss of time.

MR. L. C. BIHLER: In order that the records of the Railway Club may be historically correct I might make a correction of Mr. Stark's remarks about the birthplace of the open steel car. It occurred a little before the opening of the McKees Rocks plant. It was at the Keystone Bridge Works in 1896, where two steel hopper cars were built, which are still in service on the Bessemer Railroad. They were abnormally heavy; they weighed about 40,000 pounds. For part of the time, four or five years, those cars traveled on the Erie & Pittsburg, hauling ore between Erie and Pittsburgh, and the weight of the car plus the safe lading was 88,000 lbs.; full lading was too great for some of the trestles, so the cars were never loaded full. They were transferred to the Bessemer road a little later and were renumbered; they are still in use and have the lowest cost for repairs that the Bessemer has for steel hoppers.

Mr. Stark and Mr. Summers both referred to a question that is very important, the repairs of steel cars as the result of going through car dumpers. That is a very important and much neglected subject. It should have had attention three or four years ago, but we were all so busy that the time did not arrive until lately to make a satisfactory and thorough examination and investigation of the merits and defects of all car dumpers, relating not only to those in use at furnaces unloading ore, but also those at lake ports unloading coal. There was a committee appointed by the railroads not long since, Mr. Carson is a member of that committee, which did very thorough work. They examined some 28 car dumps located at various points on Lake Erie, iron and steel works in the Mahoning Valley district, Johnstown, Buffalo, Pittsburgh, Mingo and other districts, and their records showed that there was not one car dumper handling cars where all the cars come through safely and without any damage. Briefly, the report showed that something over 90% of the cars that went through were damaged in some shape or other. Not all were made so defective that they could not be useful for service, but they were in a different condition after they passed through the dumper. I did not examine the report very closely, but I heard it read, and among the suggestions made in regard to changes in the car was one relating to the grab irons or hand holds and roping staples. These grad irons on the side of the cars are pretty nearly in every case mutilated. Where they are now on the side of the cars they should be placed on the ends where the clamping apparatus cannot crush it. That is a serious point, considering that under the National Safety Appliance Act a car is defective which has a bent, broken or twisted handhold.

I am sorry Mr. Postlewaite resurrected that old dynamite story. I thought he knew that everybody receiving frozen ore is using steam to thaw it. As to the remarks of others regarding the wearing out of floor plates, I think we all ought to be glad to see them wear out. It is the best kind of a sign, it is a sign that prosperity is abroad in the land. I will wager that everyone here agrees that we would all rather see them wear out, than see them in the present depressed trade condition rusting out for lack of work.

MR. POSTLETHWAITE: Referring to Mr. Bihler's remarks as to the birth of the two steel cars which he described, I am reminded of the man in a Pullman car who confided to the porter that there had been a birth of twins at his house during the day. The porter remarked, "Boss, dat was no birth, dat's a section." However, I knew about those two cars and they were the foundation of much serious thought in the early days of the steel car business, and the comments heard tonight, in so far as the birth of the steel car is concerned, were meant to refer to the starting of the manufacture of steel cars in large numbers. As a matter of fact, the original tracing from which the Pressed Steel Car Company figured is dated 1889.

MR. F. H. STARK: My friend Bihler wants to take a little glory about thawing out ore with steam. We originated that over on the C. L. & W. branch of the B. & O. twelve years ago.

There is one thing I want to emphasize that was brought out by Mr. Carson's paper, and that is the thought of designing cars with a view of economical repairs without sacrificing first cost and dead weight. That is a point they can improve on if they will get around and visit Mr. Carson.

What I arose to do is to move that we extend a vote of thanks to Mr. Carson for his very able paper, which will be read with a great deal of interest by all the members of the Club.

The motion being duly seconded, was carried unanimously.

UPON MOTION, Adjourned.

# SEMI-ANNUAL MEETING
# SOCIETY RAILWAY CLUB SECRETARIES.

The Society of Railway Club Secretaries held its semi-annual meeting at the office of the Secretary, Mr. Harry D. Vought, New York City, on January 18, 1908. Present:

James Powell, Chairman, Canadian Railway Club.

Harry D. Vought, Secretary-Treasurer, New York Railroad and Central Railway Clubs.

George H. Frazier, Secretary-elect, New England Railroad Club, who was introduced by his predecessor, Mr. Edward L. Janes, who was also present.

Minutes of the annual meeting were approved.

The Committee on uniformity and standardizing of blank forms, not being prepared to make a complete report, it was, on motion of Mr. Janes, continued, with the understanding that their full report would be presented at the annual meeting.

Messrs. Daniel M. Brady, George H. Frazier and Harry D. Vought were appointed a committee to arrange for the dinner at the annual meeting in June, 1908, and entertainment in connection therewith.

On motion, Mr. Frauenthal, of the St. Louis Railway Club, was invited to prepare a paper for the annual meeting on such subject as it might please him to select.

There being no further business, the Committee adjourned.

Respectfully submitted,

Harry D. Vought,
Secretary-Treasurer.

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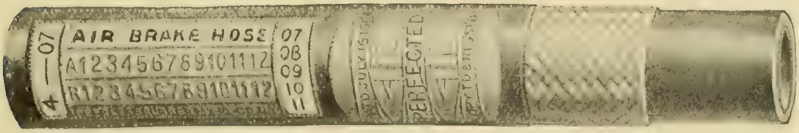

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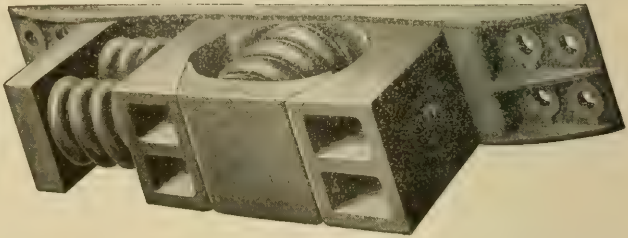

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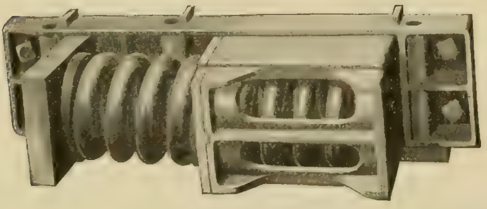

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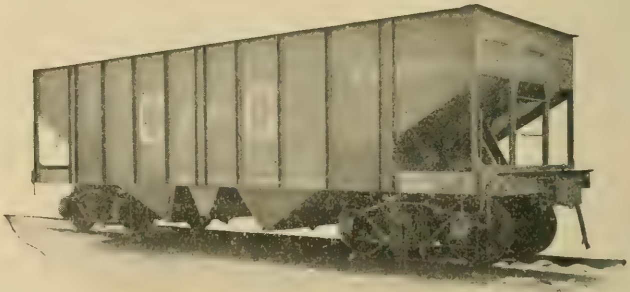

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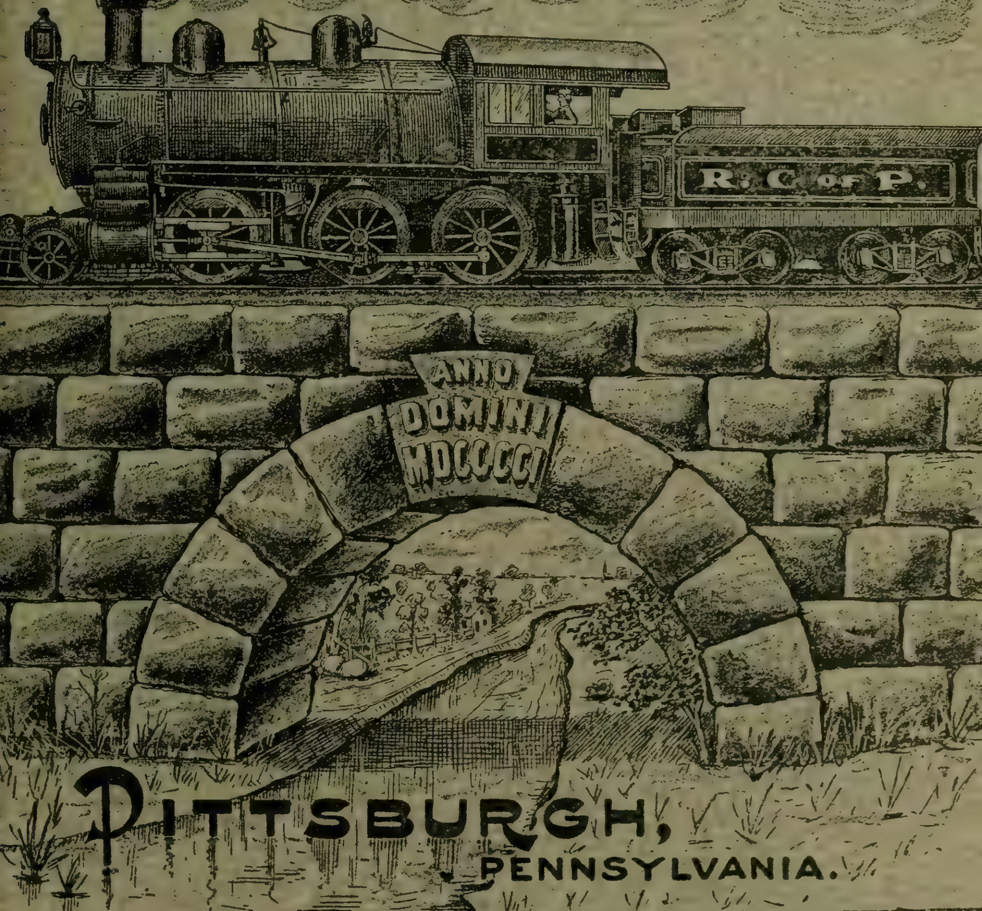
## OFFICIAL PROCEEDINGS.



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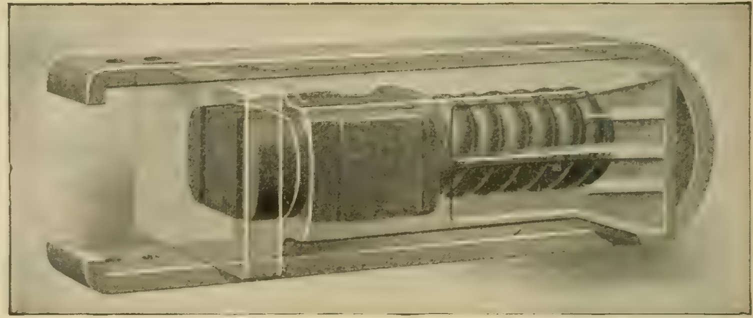

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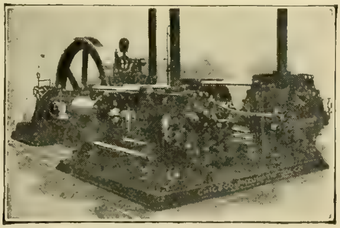

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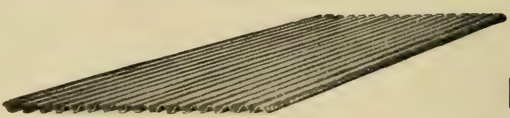

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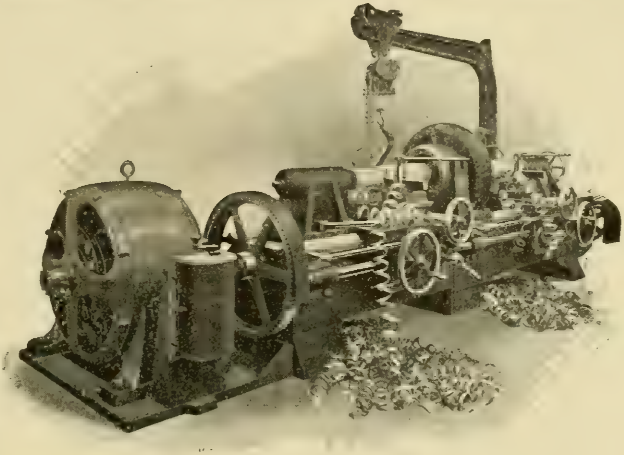

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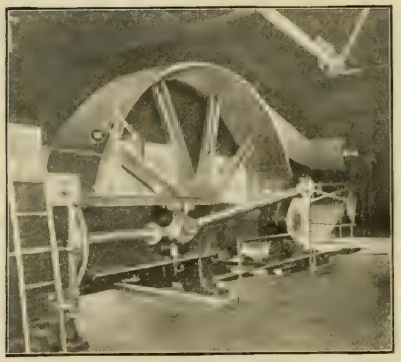

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# OFFICIAL PROCEEDINGS

*of the*

# Railway Club *of* Pittsburgh.

ORGANIZED OCTOBER 18, 1901.

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VOL. VII,
No. 5.

Pittsburgh, Pa., March 27, 1908.

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Published monthly, except June, July and August, by the Railway Club of Pittsburgh, J. D. Conway, Secretary, General Offices P. & L. E. R. R., Pittsburgh, Pa.

*Meetings held fourth Friday each month, except June, July and August.*

## PROCEEDINGS OF MEETING,

## MARCH 27th, 1908

The meeting was called to order at the Monongahela House, Pittsburgh, Pa., at 8 o'clock, P. M., with Vice-President D. J. Redding in the chair.

The following gentlemen registered:

## MEMBERS.

Anderson, J. B.
Baker, J. H.
Barnsley, Geo. T.
Beatty, E. G.
Brown, Geo. P.
Brownscombe, G. J.
Burkhard, A. A.
Chapin, E. S.
Charles, J. G.
Colburn, Wm. W.
Cole, Jewett,
Conway, J. D.
Coulter, A. F.
Crouch, A. W.
Degener, P. A.
Deckman, E. J.
Dickerson, S. K.
Drayer, U. S.
Dyer, Joseph.
Gallinger, Geo. A.
Gano, J. H.
George, M. E.
Gies, Geo. E.
Gray, Robt.
Haring, Ellsworth.
Harris, J. D.
Hepburn, M. J.
Herrold, A. E.
Hinsdale, C. L.
Irwin, Oliver
Jenny, Jacob.
Kennedy, Jas.
Kerr, Geo. M.
Kinter, D. H.
Kleine, R. L.
Knickerbocker, A. C.
Knight, E. A.
Koch, Felix.
Krause, Julius.
Lair, H. J.
LaMar, A.
Leary, E. B.
Lehr, H. W.
Lenhart, C. W.
Lindstrom, Chas. A.
Lobez, P. L.
Long, R. M.
Lynn, Samuel.
Maguire, W. E.
Mason, E. F.
Mason, Stephen C.
Mawhinney, M. S.
Meredith, H. P.
Millar, C. W.
Miller, J. F.
Milliken, I. H.
Minor, H. C.
McClumpha, H. E.
McConnell, C. H.
McFeatters, F. R.
McKee, Ira E.
McNulty, F. M.
McVicar, G. E.
Neely, J. L.
Noble, D. C.
Painter, Joseph.
Peach, Wm. M.
Porter, H. V.
Proven, John.
Pulliam, O. S.
Rauch, T. T.
Redding, D. J.

Reeve, F. J.
Riddell, Wm. J.
Rinehart, H. W.
Ryan, W. F.
Searles, E. J.
Shannon, Chas.
Sitts, Lewis S.
Smith, D. W.
Smith, M. A.
Stuart, Malcolm D.
Suckfield, G. A.
Swann, J. B.
Sweeley, G. P.
Taylor, H. G.
Walker, J. W.
Walther, G. C.
Warne, J. C.
Weimer, H.

## VISITORS.

Bixler, H. C.
Brown, James A.
Chandler, Geo. J.
Cunningham, D. F.
Diehl, H. M.
Dickinson, F. W.
Fisher, A. G.
Hilberry, H. H.
Hink, Geo. L.
Hirsch, Richard.
Hunt, Thos. B.
Johnson, John F.
Kendig, R. B.
Klein, N. P.
Lozier, J. W.
Mousselet, M. E.
McMillan, Charles.
Noah, James T.
Noble, H. S.
Reinhardt, A. L.
Roche, Thos. M.
Ruff, J. E.
Sheedy, M. M.
Smith, B.
Smith, E. W.
Smith, Sion B.
Tinker, Uriah.

The minutes of the last meeting being in the hands of the printer, the reading of them was dispensed with.

The Secretary read the following list of proposals for membership:

Bixler, H. C., Asst. Train Master, Penna. R. R. Co., 15th St., Pittsburgh, Pa. Proposed by W. J. Riddell.

Dickinson, F. W., M. C. B., B. & L. E. R. R., Greenville, Pa. Proposed by J. K. Booth.

Hansen, Chas., Jr., Standard Steel Car Co., Butler, Pa. Proposed by Geo. L. Ball.

Laudenbeck, H. C., Chemist, W. A. B. Co., Wilmerding, Pa. Proposed by Sam'l. G. Stafford.

Moore, J. T., Passenger Conductor, P. C. C. & St. L. Ry. Co., Carnegie, Pa. Proposed by J. L. Neely.

Morrison, John M., Engineer, D. & H. Co., No. 7 Birkett St., Carbondale, Pa. Proposed by J. Rosenstock.

Noah, James T., General Yard Master, Monongahela Connecting R. R. Co., Second Ave. near Bates St., Pittsburgh, Pa. Proposed by F. M. McNulty.

Northwood, W. G., Scale Agent, Penna. R. R. Co., 809 Peebles St., Wilkinsburg, Pa. Proposed by W. J. Riddell.

Quigley, G. E., Foreman, P. & L. E. R. R. Co., Haselton, Ohio. Proposed by C. L. Hinsdale.

Thomas, W. R., Road Foreman of Engines, D. & H. Co., 83 Salem Ave., Carbondale, Pa. Proposed by J. Rosenstock.

Vincent, J. E., Traffic Manager, Pittsburgh & Buffalo Coal Co., Sheraden, Pa. Proposed by J. L. Neely.

PRESIDENT: I regret to announce the death of two members of this Club, Mr. J. K. Kerr, Trainmaster of the Monongahela Connecting Railroad, who died March 3rd, and Mr. Richard S. Mercer, agent of the American Brake Shoe & Foundry Co., of New York, who died February 23rd. I will appoint as committees to draft suitable memorial resolutions on the death of Mr. Kerr, Messrs. F. M. McNulty, F. S. Weigel and John L. Tucker; on the death of Mr. Mercer, Messrs. George A. Post, F. W. Sargent and Daniel M. Brady.

There being no further business, the report of the Committee on the Revision of M. C. B. Rules of Interchange was presented by Chairman Mr. R. L. Kleine.

## Report of Committee of the Railway Club of Pittsburgh on the Revision of M. C. B. Rules of Interchange.

Mr. President and Gentlemen:

Your Standing Committee on the Revision of the M. C. B. Rules of Interchange has very carefully considered the 1907 Rules, and submit for your consideration, such changes, corrections or additions which, in the opinion of your committee, it was thought desirable to submit to the Arbitration Committee for their consideration.

The changes in the rules proper are based upon the experience of your committee with the 1907 rules, and while some of the recommendations may be considered of minor importance, they are suggested with a view of strengthening the rules, besides tending to uniformity of interpretation and practice by car repairmen, car inspectors and other parties handling the M. C. B. work for the different railroads.

Your committee has refrained from making recommendations for changes in prices for material and labor, generally, but has suggested a few corrections where prices are not consistent, and a few desirable additions.

Circular of Inquiry to the members asking for suggestions regarding the revision of the Rules of Interchange was sent out by our Secretary, but your committee regrets to state that very few replies were received in answer to this circular. The recommendations which came to hand were very carefully considered.

## CHANGES RECOMMENDED IN THE M. C. B. RULES OF INTERCHANGE.

### RULE No. 1.

Add the words *and adjusting brakes* in the third line after the word *inspection,* and omit the word *and* before the word *inspection.*

The Arbitration Committee in the supplement issued to the 1907 rules under Rule No. 107, page 48, suggests the following addition: *No charge to be made for adjusting air brakes.* Each railway company should adjust the brakes on foreign cars, which should include the adjusting of the brakes for piston travel, as well as handbrake, and no charge should be made for this work, as it is necessary for the safe handling of the car. Therefore, it is thought advisable that the above addition be made to Rule No. 1, in addition to incorporating it in Rule No. 107.

### RULE No. 2.

Insert after the word *form* in fourth line of second paragraph the following: *Filled in with ink or black indelible pencil.*

This addition is suggested that the making out of the return card will conform to the requirements of using ink or black indelible pencil the same as for defect and repair cards. If ordinary pencil is used, the writing often becomes indistinct, or entirely obliterated.

### RULE No. 2—Continued.

Change the heading on return card to read: *Bad Order Return Card.*

In order that the heading of the return card may clearly specify the reason for the return of the car, it is thought advisable to change the heading of this card, as above recommended. While the body of the card clearly states that the car is returned for the following defects, at the same time, if the heading is changed, as above described, it will indicate to all parties handling cars the cause for returning the car without reading the card in detail.

### RULE No. 3.

That the car number and initials be changed from the top to the bottom of the card, as per form attached.

NOTE—Fill in defects on both sides with ink or black indelible pencil. Attach this card with four tacks on outside face of intermediate sill between cross tie timbers.

**M. C. B. DEFECT CARD**

(Name of Road)

Date..........................................

Car specified below will be received at any point on this Company's Line with the following defects:

.......... ..........................................................

..........................................................................

..........................................................................

Car No............................Initials............................

..............................Inspector at..............................

Send bill on this card to

This is to assist bill clerks and others who examine defect cards, when the bill has been rendered. The cards and bills are fastened together at the top, and without making detachments it is not possible to check up the car initials and number. If this change is made, it will also conform to the present standard repair card.

**RULE No. ——**

Seams one inch long or over at a distance of ½″ or less from the throat of flange, change to read: *Any seams at a distance of one-half inch or less from the throat of the flange.*

Any seam in the throat of the flange is dangerous, inasmuch as it is impossible to determine from a surface inspection the length of the same, as it very frequently shows at the surface a certain length and then extends further under the surface. As the length of the seam, therefore, is indeterminable and dangerous at any length, before the flange is broken off, the dimension for same should not be specified.

**RULE No. 11.**

Change the dimension of thick flange from 1 7-16″ to 1 19-64″, and change Figure No. 2 to show the new standard maximum flange thickness gauge, as per M. C. B. Sheet 12, 1907 Proceedings.

As the M. C. B. 1907 wheel has been adopted as standard last year, this rule should be changed to conform, and the correct maximum flange thickness gauge shown in Figure No. 2.

**RULE No. 14.**

Add the words *cracked or* before the word *broken* in first line.

There are numerous cracked flanges caused by seams removed from service before the flange is broken, and while Rule No. 14 covers broken flange caused by seams there is nothing now in the rules to specify owners' responsibility when wheels are removed on account of cracked flanges caused by seams. When wheels are discovered to have cracked flanges, due to seams, they should be removed from service, from a safety standpoint, and the rule should be modified to cover the same.

### RULE No. 18.

Strike out *if chip is on outside of flange,* and insert *if chip is on the opposite side from throat of flange.*

To enable car repairmen and inspectors to determine which is the inside and outside of the flange from the present wording of the rule, it is particularly difficult to determine this when the wheels are mounted and setting on the rail. As an illustration, an inspector is directed to gauge wheels for bent axle, and is requested to measure the wheels between the inside of the flanges which really refers to the back of the flanges. To clearly distinguish what is meant in Rule No. 18 from what is specified in Rule No. 20, it is believed that this rule should be modified, as suggested.

### RULE No. 21.

That the gauges shown in Figures 1, 3, 4, 4-A and 5 should be so changed as to eliminate the throat radius.

An examination of worn flange wheels shows that the radius at the throat varies, and is generally ⅜″ and more, indicating that a gauge with any throat radius causes more or less confusion among inspectors and others in determining whether or not the flanges are sufficiently worn, and judgment, therefore, must be used in condemning wheels, which judgment is consequently not uniform at different inspection and interchange points.

The present gauge shown in the M. C. B. Rules of Interchange has 3-16″ radius at the throat while the gauge shown in the M. C. B. Standard adopted last year provides for a ⅜″ radius at the throat. While the ⅜″ throat radius is better adapted to the radius to which wheels are worn, it is not entirely satisfactory.

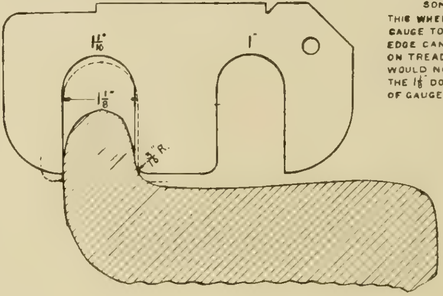
Inspectors and others do not condemn wheels uniformly by the wheel defect gauge, for the reason that the fillets at the throat of wheels differ from the radius on the gauge, preventing the latter from properly seating in throat, and from resting on the tread; which results in the gauge not being applied perpendicular to the side of the wheel, and if the gauge is rocked towards back of flange the probability of condemning the wheel is lessened, whereas, if it is inclined towards tread the wheel is condemned before it should be. Even though the gauge is applied squarely, there is a question, in many instances, as to the exact condemning points. To illustrate, see Figures 1 and 2 which show the present gauge in the Interchange Rules and the M. C. B. standard gauge applied to a worn flange wheel taken from service.

Owing to the conditions refered to, it is thought desirable to entirely eliminate the throat radius from the gauging point.

It is, therefore, recommended that a gauge with the throat radius eliminated, as shown in Figure 3, and strictly gauging the thickness of flange at a certain point above the tread better meets the requirements, which point should be approximately 11-32″ above the tread. In condemning wheel flanges with this gauge the bottom of gauge must rest on tread before the flange is condemned. The rest should be of a length so as not to be affected by the wear of the tread. The part of the gauge which rests on the back of the flange is ¼″ above that portion of the gauge which sets on the tread, so constructed for the reason that the lines of the new M. C. B. wheel flange leave the lines of the old M. C. B. Standard at this point, therefore, this gauge would be applicable to both the new and the old form of wheel flange, and when the flange of the new wheel is worn to the limit of this gauge, it will be stronger through the section at the throat than the old form of wheel flange on account of the reinforcement at the back of the flange.

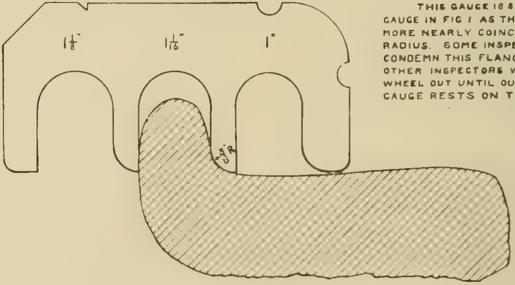
It has been found that the opening in the present wheel defect gauge for 80,000 and 100,000 pounds capacity cars removes a wheel flange from service which has been worn thin when it is still within the limits of safety for thickness,

Fig 1
PRESENT INTERCHANGE RULES



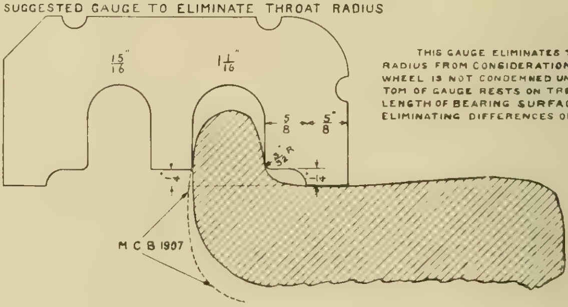
SOME INSPECTORS WOULD CONDEMN THIS WHEEL WITH THE $1\frac{1}{16}$" OPENING, AS GAUGE TOUCHES IN THROAT AND OUTER EDGE CAN BE SLIGHTLY TILTED TO REST ON TREAD, WHEREAS OTHER INSPECTORS WOULD NOT CONDEMN THIS FLANGE WITH THE $1\frac{1}{8}$" DOTTED OPENING, AS THE BOTTOM OF GAUGE DOES NOT REST ON TREAD

Fig. 2
M C B STANDARD ADOPTED IN 1907.



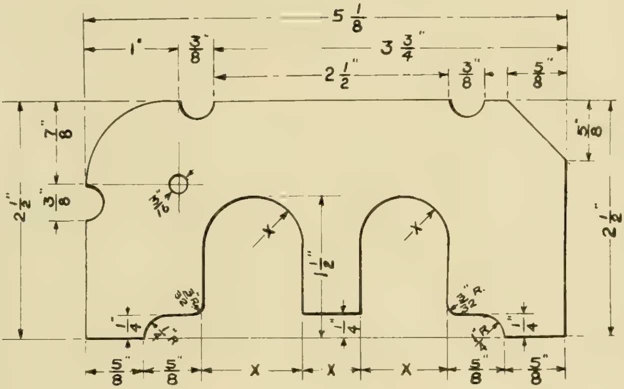
THIS GAUGE IS SUPERIOR TO THE GAUGE IN FIG 1 AS THE RADIUS ON GAUGE MORE NEARLY COINCIDES WITH THROAT RADIUS. SOME INSPECTORS WOULD CONDEMN THIS FLANGE, WHEREAS OTHER INSPECTORS WOULD NOT TAKE WHEEL OUT UNTIL OUTER EDGE OF GAUGE RESTS ON TREAD.

Fig. 3
SUGGESTED GAUGE TO ELIMINATE THROAT RADIUS



THIS GAUGE ELIMINATES THROAT RADIUS FROM CONSIDERATION AND WHEEL IS NOT CONDEMNED UNTIL BOTTOM OF GAUGE RESTS ON TREAD ENTIRE LENGTH OF BEARING SURFACE, THUS ELIMINATING DIFFERENCES OF OPINION

SUGGESTED WORN COUPLER LIMIT AND WHEEL DEFECT GAUGE.



NOTE:—
GAUGE TO BE MADE OF 1/8" STEEL CASE HARDENED.
"X" TO BE DETERMINED

providing no seams exist in the throat, and if seams do exist in throat, the thickness of the flange is not the prime factor, as flanges are broken from wheels before they have reached the condemning limit for thickness, and it is, therefore, suggested that the opening in the new gauge should be made to condemn the same thin flange wheel that the present gauge in the Interchange Rules condemns. This would be approximately an opening of 1″ on the wheel gauge suggested for a wheel which would be condemned with a flange 1 1-16″ with the present gauge and 1 5-16″ for the wheel which would be condemned with the present gauge in the Rules of Interchange measuring 1". The decrease in this dimension is due to measuring the flange at a point higher up from the tread.

It is, therefore, recommended that the proposed gauge be presented to the Arbitration Committee with the suggestion that they have the Wheel Committee approve of this form of gauge after they have fixed the dimension for the opening for condemning the thin flanges.

### RULE No. 21.

Figure 6. Add a note to this cut, as follows: *For wheels cast prior to the new M. C. B. standard tread and flange, adopted in* 1907. Also add a new cut showing the manner of gauging wheels with the new M. C. B. form of wheel tread and flange adopted in 1907.

To provide for the mounting of wheels cast in accordance with the M. C. B. 1907 form of wheel tread and flange.

### RULE No. 23.

Omit reference to 30,000 pounds capacity cars.

As 30,000 pounds capacity cars are no longer in service, it is suggested that reference to this size of axle be omitted from the rules.

### RULE No. 28.

Add after Rule No. 28, a new rule, as follows: *Cars equipped with steel wheels, and so stenciled, if found with cast iron wheels, delivering company responsible,* also change Rules 4 and 46 to include the number of this new rule.

Cars equipped with steel wheels are being returned to the owners with one or more pairs of cast iron wheels substituted for steel wheels, and no repair cards on the car to show where the change of wheels has been made. Inasmuch as this is evident wrong repairs, it is thought advisable to make the delivering company responsible for such wrong repairs, when offered in interchange.

**RULE No. 30.**

Change to read: *Cylinder or triple valves of air brake cars not cleaned, oiled and tested within twelve months, and the date of last cleaning, oiling and testing marked on the brake cylinder, auxiliary reservoir, or location on car provided for same with white paint.*

Triple valves are being cleaned, oiled and stenciled without any effort being made to test the same after this work is done, and furthermore, the stenciling is placed, in some cases, on the auxiliary reservoir, and in other cases, where the brake cylinder and reservoir are hidden under the car, is placed for convenience on the side of the car in a definite location provided for same.

**RULE No. 32.**

Add the word *pipe* after *air brake fittings* in second line, and add the words *release valve rods* after *release valves* in fourth line.

Delivering company should be responsible for pipe and release valve rods missing when offered in interchange the same as other parts of the air brake enumerated in this rule.

**RULE No. 34.**

Add before *hose* in second line, *pipe, valves, fittings.*

Pipe, valves and fittings should be included with hose and couplings at owner's risk, as the owner is now responsible for the hose and couplings unless the car is stenciled that it is so equipped, and should be equally liable for the entire temporary equipment.

**RULE No. 35.**

Omit *on and after September 1st,* 1908.

When the new Rules of Interchange go into effect, this date will be unnecessary.

**RULE No. 37.**

Omit *on and after September 1st,* 1908.

When the new Rules of Interchange go into effect, this date will be unnecessary.

### RULE No. 39.

Add the word *rivets* after the word *bolts* in last line.

Inasmuch as grab irons are fastened to the sides and ends of steel cars by rivets. Furthermore, provision is made in applying same with rivets in the Standards of the Association under the heading of *Protection to Trainmen.*

### RULE No. 40.

Add to the end of this rule: *Except destination cards not exceeding* 5″ x 9″ *if tacked on the car.*

These cards are used by railroad companies and shippers to show destination of car, and when used for this purpose alone, and do not exceed the above dimensions, they should not be considered as temporary advertisements.

### RULE No. 43.

Omit the words *intended to be* from the first line.

The rule as it now stands conveys the wrong meaning.

### RULE No. 44.

The committee recommends adding new paragraph to this rule, as follows: *Cars equipped with M. C. B. couplers,* 5 x 7 *shank, and so stenciled, if found with couplers having a different size of shank, delivering company responsible.*

A 5 x 5 shank coupler if substituted for a 5 x 7 shank coupler is weaker, and interferes with the proper mating of couplers on account of giving additional side clearance. Furthermore, both a 5 x 5 and a 5 x 7 shank coupler are M. C. B. Standards, and shown in the Rules at different cost prices, therefore, should not be substituted for one another. If the car is stenciled that it is equipped with 5 x 7 shank couplers, we believe that the substitution of wrong couplers or coupler butts for the standard, should be deemed a delivering company's responsibility, as it is evident wrong repairs, and furthermore interferes with the proper operation of the car.

### RULE No. 44—Continued.

That the words *tail pin attachments* be changed to *stem or spindle attachments.* A tail pin attachment is what is generally known as a vertical pin in the yoke, whereas, a spindle or stem attachment is meant in Rule No. 44. This is referred to as *spindle* in Rule 46, and confusion has resulted on account of same.

### RULE No. 46.

Add the words *stem or* before the word *spindle* in fifth line.

This change is suggested to conform to change in Rule No. 44.

### RULE No. 48.

Omit the following from combination: *Combined front and back coupler stop, filling block.*

It is believed that the combined coupler stop and filling block, if found broken in conjunction with the coupler or end sill, is too weak in design to properly withstand the service to which it is subjected. These parts can, and should be made of sufficient strength to withstand service shocks, and their failure is usually the origin of accompanying damage to either coupler or end sill; furthermore, the failure of such stops often results in the coupler being pulled out. If these combined coupler stops and filling blocks were removed from combinations, and the cost of same placed upon the owners, it would result in these parts being more strongly designed, and avoid the failures on the road. When a coupler stop or filling block fails, it is necessary to set the car off, and delay the freight, and it is with a view of reducing this trouble to a minimum that the above recommendation is made.

### RULE No. 50.

Eliminate Rule No. 50.

For the same reasons as given in Rule No. 48.

**RULE No. 53.**

Omit *Combined front and back coupler stop, filling block.* For the same reasons as given under Rule No. 48.

**RULE No. 56.**

Second note under Rule No. 56. Add to the end of this note: *Neither shall damaged draft timbers and end sills be considered a combination of defects, when arising from the failure of same.*

When an American continuous draft key or rod breaks, it usually results in damaging the end of the draft timber which is slotted for the key, coming to a bearing against the carrier iron bolts, which results in the splitting off of the end sill. As such damage is unavoidable when an American continuous draft rod or key fails, the owner should be held responsible for such failures.

**RULE No. 56—Continued.**

Third note under Rule No. 56. Add the word *not* before *damaged* in second line, and omit *unless shown to the contrary.*

It is usually found that where couplers or their attachments have been pulled out from a car, that they are not damaged. Furthermore, Rule No. 87 provides that bills may be rendered against car owners for the labor only of replacing couplers and other attachments, when found missing, which assumes that the coupler and attachments are not damaged, and the same assumption should be made in the note under Rule No. 56. When a car reaches a shop it is impossible to determine whether the coupler and attachments, if missing, have been damaged, and as these missing parts are usually the result of a let go, they should not be considered broken. By assuming that the parts are not damaged, it will be consistent with Rule No. 87, and will be equitable to all roads, and eliminate the personal factor as to whether these parts are or are not looked up by the party making the repairs.

### RULE No. 63.

Combine second paragraph of Rule 77, at top of page 28, with Rule No. 63.

This portion of Rule 77 has been added to Rule 63 inasmuch as it treats on the kind of repairs made, and, therefore, should be under the heading of *Instructions to Car Repairmen,* being closely associated with the present information given in Rule 63.

### RULE No. 65.

Change first sentence of second paragraph, at top of page 22, as follows: From *within* 30 *inches of either* to *within* 30 *inches of body bolster.*

There are quite a number of cars where the distance is so short between body bolster and cross tie timber that it is impossible to splice the center sills and have the splice located 30 inches from either. The change will provide that the splice must not be within 30 inches from the body bolster, but must be located between body bolster and cross tie timber.

### RULE No. 65—Continued.

Add to the end of second paragraph the following: *Except on cars equipped with four intermediate sills, when the intermediate sill adjacent to center sill may be spliced forward of body bolster, when either one or both center sills have been spliced.*

The above modification is suggested to permit the splicing of the inside intermediate sill adjacent to center sill when either one or both center sills have been spliced on cars equipped with four intermediate sills, providing the intermediate sill splice can be made between the bolster and end sill. When the car is equipped with four intermediate sills it is not weakening the car to splice the adjacent intermediate sill between the body bolster and end sill of car when either one or both center sills have been spliced, and it will save considerable expense and lumber if this is permitted.

**RULE No. 65—Continued.**

Last paragraph of Rule 65. Add *at both ends of car.*

It is generally accepted and found so in practice that a steel sill may be spliced at both ends of the car without impairing its strength. Therefore, the rule should be made clear permitting this. Furthermore, it is general practice to so splice steel sills.

**RULE No. 73.**

Add to the end of this rule: *Except where repairs are made on defect card, when the expense of re-lightweighing and stenciling should be included in the bill.*

The parties making repairs on defect cards are either the owner, or intermediate road, and are compelled to do so because the party who issued the defect card was not willing to make the repairs, therefore, the added expense of re-lightweighing and re-stenciling should be placed upon the road issuing the defect card.

**RULE No. 75.**

Change to read: *When two or more cars carrying twin and triple shipments of long lading, chained together with switch chains and couplers blocked out with metal spacing blocks, are delivered at an interchange point, the receiving road shall deliver to the delivering road, at the time, an equivalent number of switch chains and metal spacing blocks (including plates, bolts and nuts) of the same size as the chains and blocks used on the cars delivered, or in lieu thereof furnish a defect card for such chains and metal spacing blocks.*

These metal spacing blocks and switch chains are shown in Recommended Practice, M. C. B. Sheets "A" and "D," and are necessary for the safe transportation of twin and triple shipments of long lading. If a substantial metal spacing block for blocking out the horn of the coupler is not provided the motion in the draft permits the load to shift on the bearing pieces, resulting in the overhang of such loads becoming greater at one end, necessitating shopping and adjusting such loads after they have traveled some distance.

The wooden spacing block crushes, and necessity of shopping loads is found frequent when wooden spacing blocks have been applied. Therefore, it would seem advisable to include metal spacing blocks in the Rules of Interchange to reimburse the roads applying same and permit such metal spacing blocks to go to destination with the load. No expense is placed on the receiving road for these metal spacing blocks if they return the same to the interchange point, when they can be exchanged for future loads received with metal spacing blocks, but it will insure these metal spacing blocks being looked after and returned to the road applying the same.

### RULE No. 76.

Add at the end of second sentence of first paragraph: *State whether the car is empty or loaded.*

This information is necessary for the billing clerk to properly prepare the bill.

### RULE No. 87.

Insert *brake pins* after *key bolts* in the fourth line, and add *lever guides* following *brake levers* in the fifth line.

Brake pins should be included with *key bolts, jaws and hangers, when lost with brake beams.* The labor only for replacing lever guides should be allowed as they are as frequently lost by themselves the same as brake levers, jaws, and bottom brake rods.

### RULE No. 89.

Omit from the tabulation of prices on page 35 the second-hand and scrap prices for 33″ and 36″ cast iron wheels, and substitute therefor a uniform credit price of $5.50 and $6.00 respectively for the 33″ and 36″ cast iron wheels.

The above recommendation is made on account of the difficulty of the inspector or repairman to judge whether a wheel removed from a car is fit for remounting, and the decision of the inspector at the time of removing the wheel from service is very often reversed by the inspector at the mounting machine. This has led to wheels being credited as scrap to be on the safe side more often than the case warrants, resulting in an non-uniformity of practice among the different railroads in the crediting of wheels removed from service. To eliminate this personal equation, your committee feels that it would be equitable to all railroads to credit wheels removed from service at a uniform credit price irrespective of the condition of the cast iron wheel, which will be in conformity with a fixed charging price. When the second-hand wheels are placed under foreign cars they will then be charged at the credit price. The credit price suggested has been figured out on a basis of the average number of wheels found good for further service, and proportioning the present scrap and second-hand values accordingly, and a uniform credit price obtained.

**RULE No. 89—Continued.**

Change second paragraph of this rule to read: *Removing, turning and replacing a pair of steel or steel-tired wheels,* $3.50 *for pedestal type of truck, and* $3.00 *for arch bar truck.*

The present prices given in the rules for this work are very much higher than the actual labor involved. To remove, turn and replace a pair of steel or steel-tired wheels involves two changes of the wheels, and assuming for an arch bar truck a price of 80 cents for making each change of the wheels would cost $1.60. Adding to this price 50 cents for handling the wheels to and from the lathe, and allowing 90 cents for turning a pair of wheels, which would cover depreciation on machine tools and equipment, would make the figure about $3.00. Considering the additional labor involved in removing and replacing the wheels in a pedestal type of truck the figure suggested, $3.50, would seem to be equitable.

**RULE No. 94.**

The following changes in the prices of material are suggested for the reasons given under each item:

*Angle cock with plain handle, 8 inch equipment,* $1.50; 10 *inch equipment,* $1.50. *Angle cock with self-locking handle, 8 inch equipment,* $1.80; 10 *inch equipment,* $1.80.

The rules at present give a price of $1.50 for angle cock for 8 inch equipment and $1.80 for angle cock for 10 inch equipment. The angle cocks for the 8 inch and 10 inch equipments are precisely the same, and, therefore, no change in the price should be made excepting for such angle cocks which are fitted with the self-locking angle cock handle.

*Pressure retaining valve, two position, 8 inch and 10 inch equipments,* $1.00. *Pressure retaining valve, three position, 8 inch and 10 inch equipments,* $2.25.

This change is suggested to provide a price for the three position retaining valve which is the manufacturer's price.

All reference made in supplement to the Rules of Interchange relative to malleable iron couplers should be omitted, and the following substituted in the price list under Rule No. 94: *Coupler body, one, malleable,* 5 x 5 *shank, credit for scrap* 90 *cents. Coupler body, one, malleable,* 5 x 7 *shank, credit for scrap* $1.00.

The M. C. B. standard specifications provide that couplers be made of steel, and all couplers applied to foreign cars must be M. C. B. Standard, and in accordance with specifications, as provided for in Rule No. 59. Therefore, no provision should be made for applying a malleable iron coupler in repairs irrespective as to whether cars are equipped with malleable iron couplers or not, as it is wrong repairs under the Rules of Interchange to apply a malleable iron coupler in repairs.

Add to the price list: *Coupler lock, one, new, charge* 40 *cents, credit* 6 *cents.*

For the convenience of bill clerks, a uniform price for *coupler locks* should be included under Rule 94, the same as for *coupler body, knuckle and knuckle pin.*

The above suggested price is an average for the different types of couplers, which meet M. C. B. Specifications, now on the market.

Omit reference in regard to malleable and steel back filled journal bearings from the supplement, and add an item under Rule 94 after *journal bearings, filled brass or bronze* *shell* and above the explanation of the arbitrary weights as follows: *Journal bearings, cast steel or malleable back, scrap, credit four cents per pound.*

The Supplement to the 1907 Rules giving the total scrap weight of filled malleable or steel back journal bearings is based on the present weight given under Rule 94 for the total length of bearings averaging about four cents per pound. In order to obtain uniformity in billing and avoid the necessity of weighing each bearing removed it is thought advisable to make an average scrap price per pound, crediting the bearing according to length as given in the present Rule 94.

Add *pipe, one inch, per foot, five cents.*

We now have a price for 1¼" and ⅜" pipe, and inasmuch as the crossover pipe is 1", we should also have a price for this size of pipe.

## RULE No. 102.

Change to read: *When M. C. B. couplers are replaced, good M. C. B. standard second-hand material may be used; when metal brake beams are replaced, good second-hand material may be used; but they must be charged at 75% of the price when new. The credits for similar parts released from service, in good condition, must also be 75% of the price when new.*

The above change in the reading of this paragraph is suggested to insure coupler parts meeting M. C. B. Specifications and Tests being used in repairs.

## RULE No. 103.

Add to the end of this rule: *Except when repairs are made on authority of M. C. B. defect card, when the freight charges may be billed in addition to the market price of the manufactured article.*

The above addition is recommended, so as not to put the road making repairs on authority of defect card to any loss.

**RULE No. 105.**

Increase the price for altering height of one end of one car, net, from $1.10 to $1.25.

It is impossible to alter the height of one end of car which includes jacking up, placing raising plank on bolster, shimming up side bearings, both labor and material, for the price given in the rules.

The rules allow 75 cents for replacing center plate bolts at one end of car, and the price of $1.10 for altering the height of one end of car is extremely low compared with the price for replacing center plate bolts.

**RULE No. 106.**

*American continuous draft rod, each weld, one hour.*

The above change is suggested as the American continuous draft rods are continually failing, necessitating welding, and the iron is in such poor condition back of the eye where the weld is usually made, and where the rod fails, that it is impossible to make a lasting job. If the price was changed to allow one hour for each weld, it would then be possible to cut out a section and weld in a new piece, and reimburse the road making the repairs for same.

**RULE No. 106—Continued.**

Eliminate reference to carry iron bolts from supplement, and combine carrier iron bolts and draft timber bolts in Rule 106, and change to read as follows: *Draft timber bolts, or carrier iron bolts, either or both, three or less, at one end of car, replacing, two hours,* 50 *cents. Draft timber bolts or carrier iron bolts, either or both, four or more, at one end of car, replacing, three hours,* 75 *cents.*

As the carrier iron bolts are so closely allied to the draft timber bolts, and inasmuch as considerable confusion has resulted since a separate charge has been allowed for carrier iron bolts and draft timber bolts, it is desirable to combine the two.

**RULE No. 106—Continued.**

Eliminate the refference in supplement to *the bolts passing* *through the rear end of draft timber and upper center plate should be considered as draft timber bolts if renewed with draft timber bolts on the same end of car, except that an additional hour may be charged for raising and lowering end of car with the additional labor provided in rules if car is loaded.*

It is not equitable to omit the charge for center plate bolts when they pass through the draft timbers, and consider them as draft timber bolts on cars equipped with draft timbers extending beyond body bolster compared with the charge for draft timber bolts and center plate bolts on cars equipped with short draft timbers extending to body bolster. The same labor is involved in both operations in that to renew the center plate bolts the car must be raised off the truck, and, therefore, this charge should be the same for cars with long or short draft timbers. We would, therefore, recommend that center plate bolts remain as at present in Rule No. 106, and be considered as a separate proposition to the draft timber bolts.

**RULE No. 106—Continued.**

Change *center pin key applied* to *center pin key or center pin without head applied.*

At the present time the rules do not cover *center pin without head applied,* and as the same labor is involved as in applying a center pin key, the two should be included in the same item.

**RULE No. 106—Continued.**

Add to the items *coupler with stem attachments* and *coupler with pocket attachments* after the words *coupler stops,* the words: *One or more coupler stop bolts, when necessary to remove coupler.*

Inasmuch as there are a large number of coupler stops applied with bolts that require the removing and the replacing of the coupler to apply new coupler stop bolts, the coupler stop bolts should be included under the above headings, as the labor involved is the same as the other itemized details in this heading.

**RULE No. 106—Continued.**

Change the price for one-half hour labor wherever it appears in the labor column, from 15 to 12½ cents.

It is now the practice of some bill clerks to add 15 cents for each separate half-hour labor charge. When checking bills, the various half-hours summed up do not check with the total money value for the hours of labor performed, and it is, therefore, desirable to charge each half-hour labor at the fractional portion of an hour. The fractional part of a cent in the labor column is no worse than the decimal part of a cent in the material column. It is, of course, understood that the total amount of the bill will be rendered in even cents.

**RULE No. 106—Continued.**

*Center pin head applied, loaded car,* change from two to three hours. *Center pin head, applied, loaded car and putting same on center* change from four to five hours.

This advance is recommended to conform to the change made last year in the increase in the price for removing load, from two to three hours. At the present time a charge of three hours is permissible for removing load to replace body center plate bolts. The same labor in removing load is necessary to apply *center pin head* to a loaded car, therefore, the charge should at least be advanced from two to three hours.

**RULE No. 106—Continued.**

Change coupler with pocket attachments, as follows: *Coupler, with single spring pocket attachments, coupler spring, one or more follower plates, one or more coupler stops, coupler pocket, coupler pocket rivets, renewing or replacing, any or all, at same end of car at same time, four hours,* $1.00. *Coupler, with tandem, twin or friction pocket attachments, coupler springs, one or more follower plates, one or more coupler stops, coupler pocket, coupler pocket* *rivets, renewing or replacing any or all, at same end of car at same time, five hours,* $1.25.

On account of the increased amount of labor involved in replacing tandem, twin or friction gears over the old single spring gear, it is considered essential to have two prices, one for the single spring gear and the other for the tandem, twin and friction gears, and four and five hours respectively for doing this work is recommended.

**RULE No. 106—Continued.**

Add the following items: *Draft timbers extending beyond body bolsters, one replaced, nine hours. Draft timber extending beyond body bolster, one replaced, when its center sill has been replaced, three hours. Draft timbers extending beyond body bolster, two on same end, replaced,* 13 *hours.*

There is a large amount of additional labor involved in replacing draft timbers that extend beyond body bolster compared with short draft timbers extending to body bolster, and it is not equitable to have one price for this work. It is, therefore, recommended that an addition be made to the present rules specifying the labor charge for replacing draft timbers extending beyond body bolster.

**RULE No. 106—Continued.**

Add *Roofing, per lineal foot,* 10 *cents.*

No price is now given in the rules for roofing, and in order that this charge may be uniform, we suggest the above addition.

**RULE No. 106—Continued.**

Add *flooring, per lineal foot,* 15 *cents.*

No price is now given in the rules for flooring, and in order that this charge may be uniform, we suggest the above addition.

**RULE No. 106—Continued.**

Add *per lineal foot* after the word *siding* for refrigerator cars.

The item for *siding* as now given in the Rules does not specify the amount to be replaced for the labor charge of 20 cents.

### RULE No. 106—Continued.

Referring to supplement: *Two center sills, wood, spliced, same end of car, ordinary car, 20 hours; refrigerator car, 24 hours.* Suggest increasing this price for ordinary cars to 22 hours, and for refrigerator cars to 26 hours.

The present allowance for each side or intermediate sill spliced when longitudinal sills have to be replaced, is given as six hours in Rule No. 106. Sixteen hours is allowed for splicing one center sill, and it would be inconsistent to allow only four hours for splicing the additional center sill when we consider that the labor is greater in splicing a center sill than in any of the other sills, on account of the necessity of removing and replacing the draft timber. In this connection, attention is called to the present allowance of six hours for splicing one center sill when either sill has to be replaced. It would, therefore, seem but equitable to change the prices as above suggested.

### RULE No. 106—Continued.

Eliminate the item *an additional charge of 75 cents shall be allowed in replacing intermediate or center sills on cars equipped with air brakes,* and add three hours to all prices for replacing center and intermedite sills.

Inasmuch as all cars offered in interchange must be equipped with air brakes, the item above referred to should be removed from Rule 106, and the three hours added direct to the labor charge given for the different combinations of center and intermediate sills. This will simplify the bill clerk's work and insure a uniformity of prices.

### RULE No. 107.

Add to this rule *no charge to be made for adjusting brakes.*

The above change is recommended for the same reasons as given under Rule No. 1.

**RULE No. 111.**

Add paragraph reading: *When pocket coupler and one or more carrier iron bolts are replaced at same end of car, the regular labor charge shall be reduced one hour.*

The above addition to the rule is recommended to conform to Arbitration Case 693. Inasmuch as this decision is overlooked in many cases, it is believed that provision for same should be made in the Rules, which would then make this matter explicit.

**RULE No. 112.**

Add *Emergency check valve, grinding in,* 10 *cents.*

No price is now provided in the Rules covering this labor. As it is found that ten cents is a fair average price for uniformity, it is suggested that the same be incorporated in the Rules.

**RULE No. 112—Continued.**

*Angle cock handle, removed and replaced,* change from 7 cents to 4 cents. *Cut out cock handle, removed and replaced,* change from 3 cents to 4 cents.

The above two repairs involve precisely the same operation, and, therefore, should be billed at the same price; four cents for either operation has been found to be an equitable price.

**RULE No. 122.**

Exception to be made to this rule, as follows: *Except in cases of trucks of* 50,000 *pounds capacity or less in which case the Railroad Company destroying the car may elect to retain the trucks and settle for same at scrap value (with the exception of wheels and axles, the value of which must be settled for in accordance with the schedules provided in M. C. B. Rules of Interchange).*

Inasmuch as these low capacity cars are being dispensed with, the expense connected with defect carding such trucks, or repairing same, when the bodies of the cars are destroyed, may well be saved.

**RULE No. 125.**

Recommend to the American Railroad Association that instructions be formulated for sending home wornout and damaged cars by the shortest route instead of as provided for in Rule No. 125.

The present rule provides that wornout and damaged cars, in order to avoid freight charges, must be sent home via the route over which the car passed from the home road. This causes undue delay to the car, and very often additional damage before such car reaches the home road. It would, therefore, be economical to make provision for sending home wornout and damaged cars by the shortest route, irrespective of route over which the car originally passed.

Respectfully submitted,

G. E. Carson,
S. A. Cromwell,
F. W. Dickinson,
G. H. Davis,
G. N. Dow,
J. Krause,
W. J. Knox,
A. La Mar,
F. J. Reeve,
J. B. Swann,
H. W. Watts,
R. L. Kleine, *Chairman.*

The report was then taken up seriatim and the report of the Committee was adopted in its entirety, with the single addition to Rule 75, at the suggestion of Mr. Gies, of *plates, bolts and nuts.*

PRESIDENT: Gentlemen, the report is now before you. It is a very important matter, and if any one can suggest any recommendation which will better the report, or any recommendation of additions to or modifications of the rules not covered by the report, or if any one has any reason why the report as presented and amended should not be carried through at this meeting, we would like to hear from him.

MR. GEO. E. GIES: I move the final adoption of the report, as amended, and also a hearty vote of thanks to the members of the Committee in appreciation of their labors in preparing and presenting this report.

MR. JOS. DYER: In seconding that motion I would like to say that this Committee have had very heavy duties to perform in getting up that paper and in studying up these matters. I think they deserve a hearty vote of thanks for their work.

The motion being put to vote was carried unanimously.

PRESIDENT: Mr. Kleine and members of the Committee, you have the thanks of the Club, and I am sure you are entitled to them for your very arduous labors.

MR. KLEINE: On behalf of the Committee I want to thank the Club for the very nice entertainment they provided for the Committee during their meetings to consider the Rules, in our stop over in Pittsburgh.

PRESIDENT: If there are no further remarks, we will entertain a motion to adjourn.

UPON MOTION, Adjourned.

# In Memoriam

## MR. JOHN K. KERR

It has pleased Almighty God in His wisdom to remove from our number Mr. John K. Kerr. Train Master of the Monongahela Connecting Railroad, who died at his home, Pittsburg, Pa., March 3d, 1908.

He was regarded as a very capable and upright man, and will be greatly missed by his employers, business associates and friends.

We, as fellow members of the Railway Club of Pittsburg, and associates in the railroad business, are united in sincere sympathy with the family in their bereavement at his removal from our midst.

*Resolved,* That these expressions of sympathy be spread on the minutes of this Club, and a copy be presented to his family.

F. M. McNULTY,
F. S. WEIGEL,
J. L. TUCKER,
Committee.

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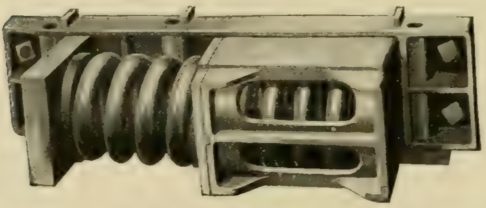

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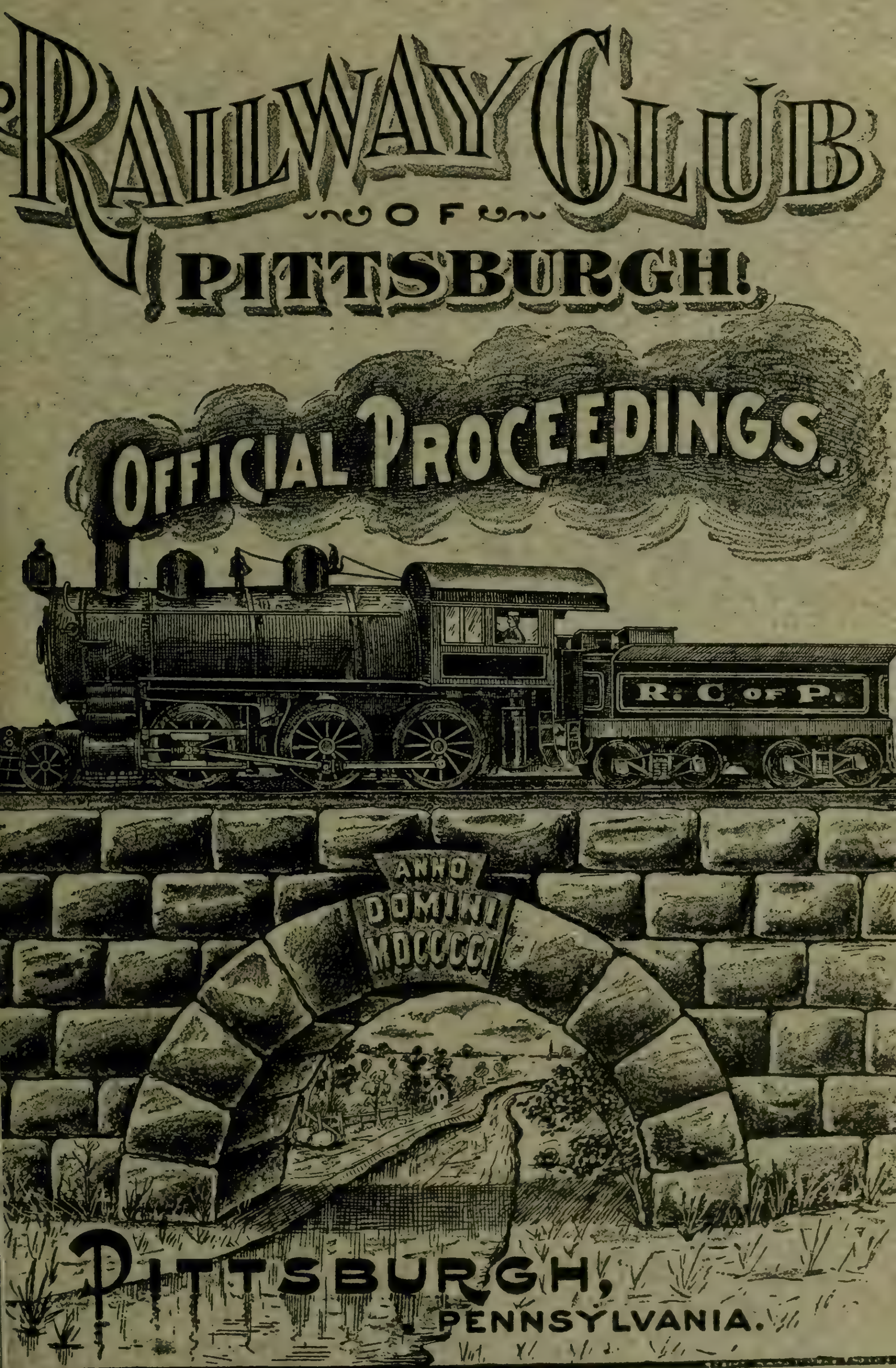

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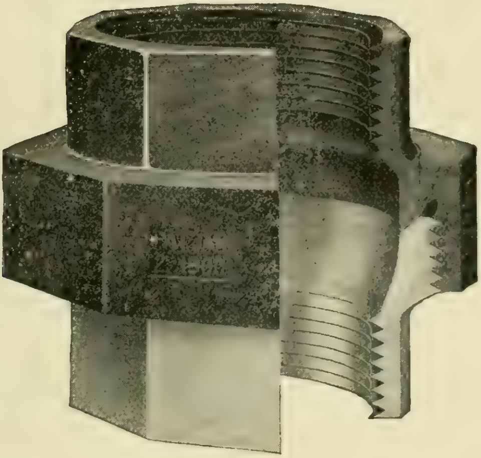

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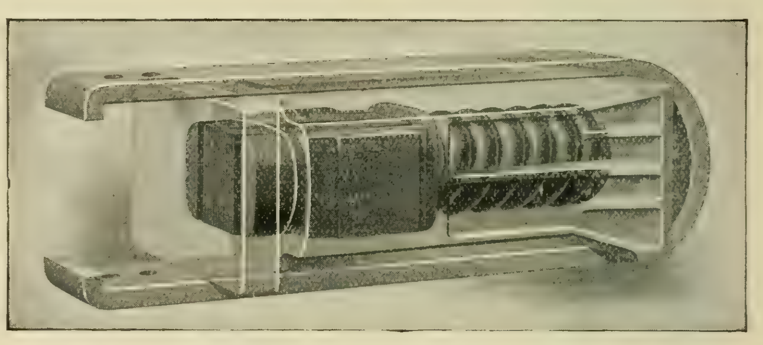

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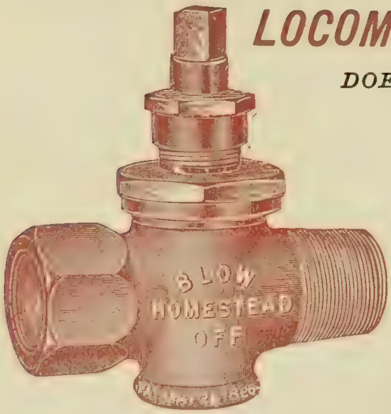

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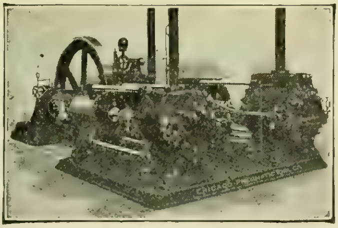

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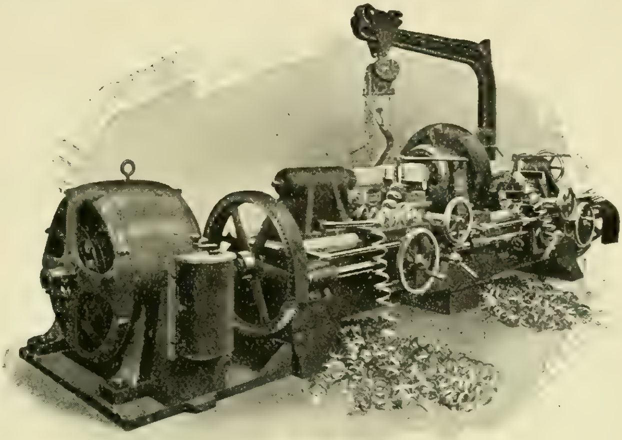

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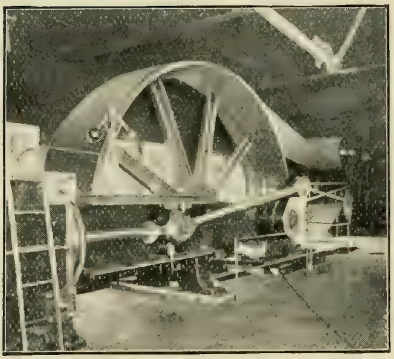

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*of the*

# Railway Club *of* Pittsburgh.

ORGANIZED OCTOBER 18, 1901.

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**Pittsburgh, Pa., April 24, 1908.**

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J. D. Conway, Secretary, General Offices P. & L. E. R. R., Pittsburgh, Pa.

*Meetings held fourth Friday each month, except June, July and August.*

## PROCEEDINGS OF MEETING,

## APRIL 24th, 1908

The meeting was called to order at the Monongahela House, Pittsburgh, Pa., at 8 o'clock, P. M., with Vice President D. J. Redding in the chair.

The following gentlemen registered:

## MEMBERS.

Bihler, L. C.
Brownscombe, G. J
Burrell, J. E.
Chapin, E. S., Jr.
Chittenden, A. D.
Colburn, Wm. W.
Conway, J. D.
Coulter, A. F.
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Decker, Omar S.
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Dix, John W.
Donahey, I. W.
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Falkenstein, W. H.
Gale, C. H.
Gallaher, A. H.
Gano, J. H.
Gardner, H.
Gearhart, J. A.
Geary, Chas. J.
Giles, J. T.
Gray, C. B.
Grindlay, L. B.
Haring, Ellsworth.
Hench, N. M.
Herrold, A. E.
Howe, D. M.
Hurley, Wm. S.
Huyett, E. G.
Hyndman, F. T.
Irwin, E. P.
Kennedy, Jas.
Kerr, E.
Kessler, D. D.
Keyser, R. H.
Kirk, T. S.
Kissinger, C. F.
Knickerbocker, A. C.
Knox, Wm. J.
Koch, Felix.
Koch, H. J.
Kull, W. A.
Lehr, H. W.
Lindstrom, Chas. A.
Lobez, P. L.
Mawhinney, M. S.
McClumpha, H. E.
McFeatters, F. R.
McKee, Ira E.
McNulty, F. M.
McVicar, G. E.
Neale, John C.
Oliver, W. H.
O'Neal, J. E.
Orchard, Charles.
Porter, H. V.
Pulliam, O. S.
Randall, E. J.
Rauch, T. T.
Redding, D. J.
Reeve, F. J.
Rinehart, H. W.
Ryan, W. F.
Sattley, E. C.
Stewart, W. W.
Sitts, Lewis S.
Stuart, M. D.
Stucki, A.
Suckfield, Geo. A.
Sweeley, G. P.
Turner, L. H.
Walther, G. C.
Warne, J. C.

## VISITORS.

Barth, John M.
Bish, Burnett.
Bolenius, H. C.
Bowes, Geo. S.
Brown, E. C.
Chandler, Geo. J.
Clark, C. C.
Diescher, Sam'l.

Dildine, J. A.
Gilbert, E. A.
Grose, James H.
Hink, Geo. L.
Holding, J. C. C.
Hoover, S. R.
Knowles, J. L.
Leech, J. O.
Lincoln, L. P.
Lozier, J. W.
Maxson, H. W.
Munn, Edward.
Murphy, W. P.
MacConnell, T. W.
Neff, H. C.
Porter, P. P.
Roche, Thos. M.
Svenson, S.
Spengler, J. G.
Unger, J. S.
Van Zandt, H.
Woodworth, R. B.
Young, J. Raymond.
Zimmerman, E. W.

The minutes of the last meeting being in the hands of the printer, the reading of them was dispensed with.

The Secretary read the following list of applications for membership:

Bolenius, H. C., Supervisor, Allegheny Valley Railway, Verona, Pa. Proposed by H. J. Koch.

Cline, W. A., Asst. Supt. Transportation and Labor, Carnegie Steel Co., P. O. Box 507, Munhall, Pa. Proposed by J. W. Benner.

Daniels, O. V., Material Clerk, Penna. R. R. Co., Union Station, Pittsburgh, Pa. Proposed by Jewett Cole.

Duffy, James A., Master Mechanic, Div. 2, Pittsburgh Railways Co., 36 Wabash Ave., Pittsburgh, Pa. Proposed by E. G. Beatty.

Fleck, J. S., Asst. Train Master, Penna. R. R. Co., Union Station, Pittsburgh, Pa. Proposed by W. J. Riddell.

Gorsuch, J. W., Asst. Material Clerk, Penna. R. R. Co., Union Station, Pittsburgh, Pa. Proposed by Jewett Cole.

Hosfield, W. G., Clerk, P. C. C. & St. L. Ry., 423 Fourth Ave., Carnegie, Pa. Proposed by J. D. Giles.

Karnes, W. T., General Foreman P. & L. E. R. R., Newell, Pa. Proposed by H. R. Warnock.

Kraft, H. B., Foreman Steel Car Dept., Penna. R. R. Co., Altoona, Pa. Proposed by E. F. Mason.

Lozier, J. W., Clerk, Union R. R. Co., 634 Corry Ave., Braddock, Pa. Proposed by A. F. Coulter.

Latta, C. E., Secretary, Hutchins Car Roofing Co., 107 S. 6th St., Goshen, Ind. Proposed by E. B. Leary.

Rogan, John A., Master Mechanic, Div. No. 1, Pittsburgh Railways Co., 125 Auburn St., Pittsburgh, Pa. Proposed by E. G. Beatty.

Zimmerman, E. W., Asst. Passenger Trainmaster, Pittsburgh Division, P. R. R. Co., Union Station, Pittsburgh, Pa. Proposed by J. E. Burrell.

VICE PRESIDENT: Since our last meeting, as you are all aware, we have lost our President by death. While Mr. Watts had been sick for a number of weeks, I think his death was entirely unexpected by most of us; at least it was by me, and I was very much surprised to learn that he had passed away.

Mr. Watts was a man universally liked and admired by those who knew him; a man of splendid, upright, Christian character, and one whom we might well be proud to have as a member and officer of this Club. He was a charter member and always took an active interest in the work of the Club, having served on several committees prior to his election as President. It was characteristic of his sterling, reliable habits of life that he made few changes in his employment, as shown by the fact that he remained in the service of the Jones & Laughlin Company for thirty-one years, practically all of his business life, having filled various positions with that company, but being perhaps best known to us as the Master Car Builder and General Agent of the Monongahela Railroad Company.

Mr. Watts was a prominent worker in the interests of the Presbyterian Church and was widely known throughout the community on account of his interest in church work. He was a man who commanded, to an unusual degree, the respect and admiration of his associates in business, and I am sure we would all appreciate at this time any expression of this sentiment by those of his former associates who may be present.

While I am on the floor I wish to announce the names of

Mr. Frank McCune, Mr. L. H. Turner and Mr. F. H. Stark as a committee to prepare a suitable set of resolutions upon the death of Mr. Watts.

I would like to call on Mr. Kirk, of the Jones & Laughlin Steel Company.

MR. T. S. KIRK: Mr. President and Gentlemen:—At the unveiling of the soldiers' monument at Springfield, Ill., President R. B. Hays gave utterance to this sentiment: "The best way to show respect for the dead is to care for the living." Following this, the best way I can show respect for our late President is to hold up for emulation his most exemplary life.

I have known Mr. Watts since his first connection with the Jones & Laughlin Steel Company, now 31 years past, and I have never known him to desert the straight path nor capable of dissembling. I know of nothing I can say more eulogistic of his life and acts than that we should accept them as a light to guide us on our journey to the great beyond.

VICE PRESIDENT: The Secretary has a communication relating to the death of Mr. Watts, which I will ask him to read.

Glenshaw, Pa., April 22, 1908.

Dear Mr. Conway:

My mother and I wish to thank the members of the Railway Club, through you, for the kindness and sympathy expressed by the beautiful floral wreath. My father was very much interested in the Club, and his election as President was one of the greatest pleasures of his life.

Very sincerely yours,

ETHEL SHAW WATTS.

VICE PRESIDENT: If there is nothing further to come before the meeting at this time, we will proceed with the paper of the evening. It gives me pleasure to introduce Mr. R. B. Woodworth, of the Carnegie Steel Company.

# NEW USES FOR STEEL.

BY R. B. WOODWORTH, M. AM. SOC. C. E., ENGINEER WITH
CARNEGIE STEEL COMPANY.

The history of the production of steel in our country reflects the development of different lines of manufacture. The increasing tonnage of plates rolled bears witness to the demand for steel cars, while the tonnage of shapes produced is witness to the development of steel frame buildings and the extension of elevated railways and other adjuncts of rapid transportation. These are what are ordinarily called "superstructures." The coming years will show, in the increased production of steel, the development of its application to substructure work as well.

In ordinary building work in our cities the foundation problem is comparatively simple, but in subaqueous foundation work there are, roughly speaking, five general methods of construction:

1st. The Cofferdam.

2nd. The Timber Crib.

3rd. Dredging through deep wells or tubes.

4th. The Pneumatic Caisson.

5th. The Freezing Process.

The purpose of this paper is to deal with the first of these, as it is under this method there has come recently the most important line of the substitution of steel for wood.

Who drove the first wooden pile is not known to history. The historian Herodotus describes structures of this class dating from the fifth century B. C., but long before the days of Herodotus the lakes of Switzerland and the alluvial coasts of Denmark were dotted with human habitations founded on wooden piles to protect the races of that day from the onslaught of human enemies or the beasts of the forest. Before the age of iron had come men sharpened sticks of timber in the fire, drove them into the soft soil and constructed thereon their dwellings.

These were round wooden piles, but in like manner the first use of wooden sheet piling for cofferdam purpose has long since been forgotten. Its long use has made man familiar with its construction, and with its defects as well, and no one can for a moment contend that wooden sheet piling is in itself a perfect material of construction, or that its use is attended with such advantages that it cannot be superseded by some similar material which is not liable to any of its disadvantages.

Its advantages are its simplicity, the ease and convenience with which material can be obtained from the nearest lumber yard, and the possibility of doing the necessary cutting and fitting with the simplest of tools by unskilled workmen. The disadvantages of wooden sheet piling are many. The formation of tongues by strips spiked to the edge of the plank prevents waste of timber, but is not as good as the tongues and grooves formed in a planing mill as in ordinary wooden floor construction. At the best, the tongues are easily split and leaks develop under water pressure, to prevent which the pile must be strengthened and braced so as not to be forced out of line. This bracing entails the necessity for additional working space, and, therefore, additional expense in driving. These disadvantages are so great that it was seen years ago that there were improvements in wooden sheet piling itself that were valuable enough to be covered by letters patent which were issued to James A. Wakefield of Chicago, E. R. Beardsley of Chicago, W. D'H. Washington of New York, G. H. Cavanagh of Boston, and others.

These improvements have overcome only in part the disadvantages referred to. There are other disadvantages which remain. It is still true that the length of wooden sheet piling is limited and that it can be interlocked perfectly only in short lengths. It has to be crowded together under driving by beveling the edges, the cutting of which adds increased expense, and even then does not produce watertight joints. Slight irregularities in the driving due to encountering boulders increase the danger of leaks which it is practically impossible under deep conditions of driving to prevent, and in extended trench work or multiple piers the material becomes so battered and distorted that it cannot be used for more than one or two installations. The single line of wooden sheet piling is only practical and watertight provided the line itself be made thick and heavy. Under ordinary conditions of driving it is preferable to drive two walls and puddle between with alluvial soil, gravel or sand.

These disadvantages are disadvantages in material. There are other and greater disadvantages inherent in the type of construction. Double wall cofferdams require to be puddled with carefully selected material. While clay can be used with a good degree of success, it will be found better to use a clayey gravel, or to mix the clay and gravel. A small leak starts through a pure clay puddle, it washes out the clay in considerable quantities, and a dangerous leak is soon developed. Moreover, in our rivers where sand diggers have been at work material for filling is uncertain and treacherous. The *Contractor,* March 15th, gives an example of the failure of a wooden cofferdam used for the purpose of building a bridge pier in the middle of the Monongahela River at Morgantown, West Virginia. During the construction of the cofferdam the contractor promised to drink all the water that would leak into it after the first pumping out. The space between the piles was filled with material taken from the hillside without special selection, and consisted of clay with gravel of various sizes, but in dumping from the end of the chute material was segregated; the coarse material was delivered to the corners of the dam, while the fine material was dropped at the end of the chute; and it became necessary to build another coffer across the corner inside, and then to excavate the original material enough to get in a core of better material, causing delay, expense and annoyance, not to mention the continual leakage.

All wooden cofferdams give more or less trouble, and Figure 1, taken at Indiana Harbor, indicates what may be looked for in this direction. This contractor built a cofferdam of steel sheet piling which was entirely successful. He, however, could not wait for the completion of his first cofferdam to reuse the material, but built the second cofferdam of wood; this second

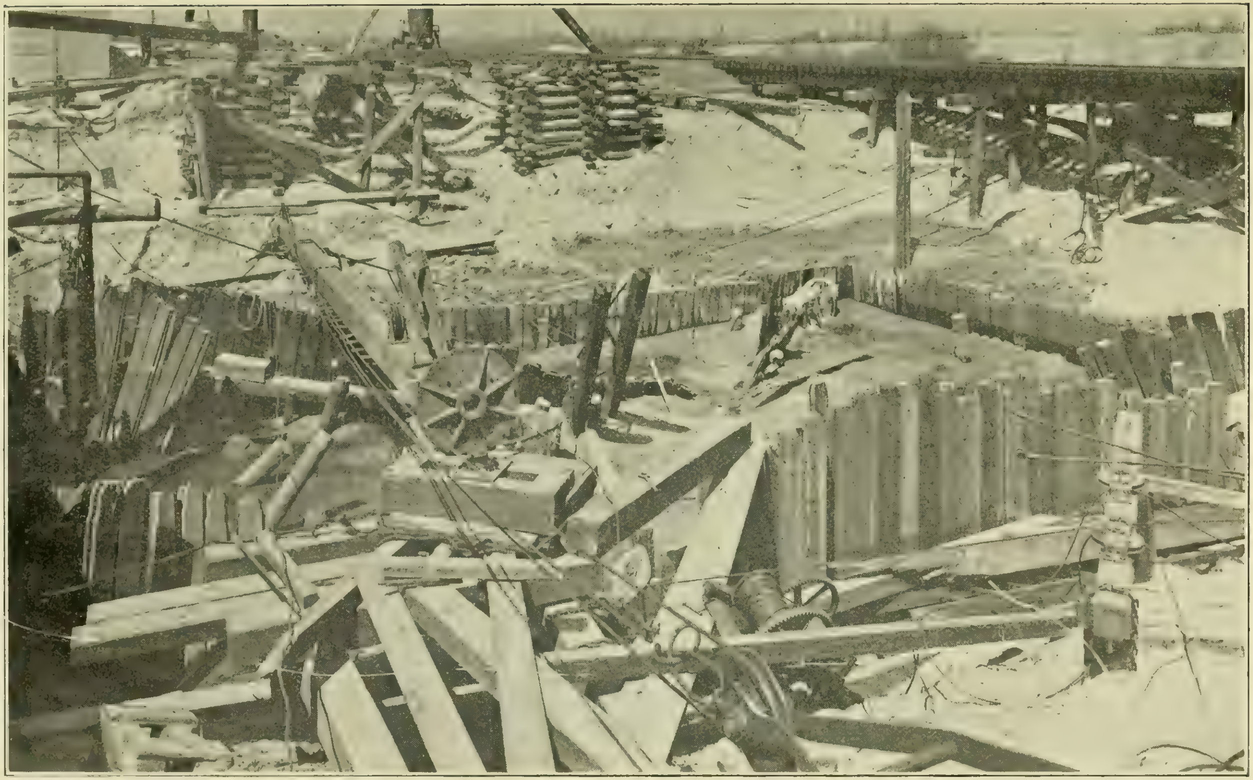


Fig. 1—Collapsed Wooden Sheet Piling Cofferdam at Indiana Harbor, Ind.

cofferdam collapsed entirely on account of high water, and the photographs show what happened to the rebuilt second cofferdam when the exterior earth pressure spent its force thereon. In order to prevent this it would have been desirable to have constructed a double wall cofferdam and to have puddled between with alluvial soil, gravel or sand. What happened to this cofferdam is not unique; the records of the engineering profession are filled with instances of similar occurrences, all of which point to the desirability of something more stable, secure and reliable.

The simplicity of the construction of piers by the cofferdam method has been a large recommendation for the use of wooden sheet piling, and, therefore, it has been that its use has been continued in spite of the numerous failures incident thereto.

The attention of contractors was first turned to cast iron as a substitute for wood, and previous to 1822 a Mr. Mathews had used interlocking cast iron sheet piles in the foundations of the head of the north pier of the Harbour at Burlington. In ignorance of Mr. Mathews' proceedings, Mr. Ewart in 1822 took out a patent for a new method of making cofferdams by the use of cast iron plates held together by cramps fitted to dovetailed edges on the piles, and his cast iron sheet piles were used in England in dock and wharf work of some importance in 1822, 1823 and 1824. Mr. Cubitt in 1832 drove cast iron sheet piles 30 feet long of his own design at the sea entrance of the Norwich and Lowestoft navigation. A year later Mr. Sibley constructed an iron wharf on the Lea Cut at Limehouse with hollow cast iron piles connected by flat plates let down in grooves on their sides. Finally in 1833-34 Messrs. Walker and Burges constructed with cast iron piles the quay-wall on the River Thames, in front of the East India Docks at Blackwall and since named Brunswick Wharf.

The defects of cast iron, however, were sufficient to prevent its taking the place of wood. There is needed a more homogeneous material of equal simplicity with wood and its superior in strength and reliability. Cofferdams of boiler plate were used on the Inch Garvie Piers of the Firth of Forth Bridge in 1884, and the steel caisson as well as steel cylinder piers have been in more or less extended use since then. Their expense is justifiable only when the material is retained as a permanent part of the structure. Movable steel cofferdams have been covered by letters patent granted to J. E. Robinson and others. Mr. Robinson's cofferdams were not very successful, but in one case, at the Schuylkill River, they were used where an ordinary cofferdam had failed entirely, and under circumstances particularly trying.

The expense of the steel cofferdam constructed of angles and plates, such as Mr. Robinson proposed, is due to the high cost of fabrication and erection. Besides, what the contractor requires is not a permanent structure, but a set of tools that can be carried about from place to place and reused repeatedly, and whose first cost is amply compensated for by the ability so to use them. When the first patents for steel sheet piling were issued, the inventors did not realize all the applications to which their inventions might be put, or that the conditions of the lumber market would ever become such as to make steel more economical than wood; their first idea being to use steel in places where wood is not applicable. Lewis Dodge, for example, in Letter Patents No. 103,028, dated May 17th, 1870, for "Improvements in the Construction of Tunnels and Dams," proposed to use his tunnel lining in making cofferdams to be filled with material for artificial stone, and extending sufficiently deep into hard bottom to protect against caving in when the excavations have been made. He proposes to use the same construction for levees, docks and piers to prevent ground-burrowing animals, such as muskrats, etc., from penetrating through embankments.

The primary application of Patent No. 500,780, granted July 4th, 1893 to August Simon, of Gnadau, Germany, is to the use of steel piles to take the place of round wooden piles ordinarily driven, and not to sheet piling as such. In his description of his invention he states that "after the pile has been introduced into the fixed layer of ground that borders the quicksand or moving ground, the hollow beams must be filled with oakum or moss. By this means a perfectly waterproof pile may be constructed, consequently the water and the mud, silt or sand

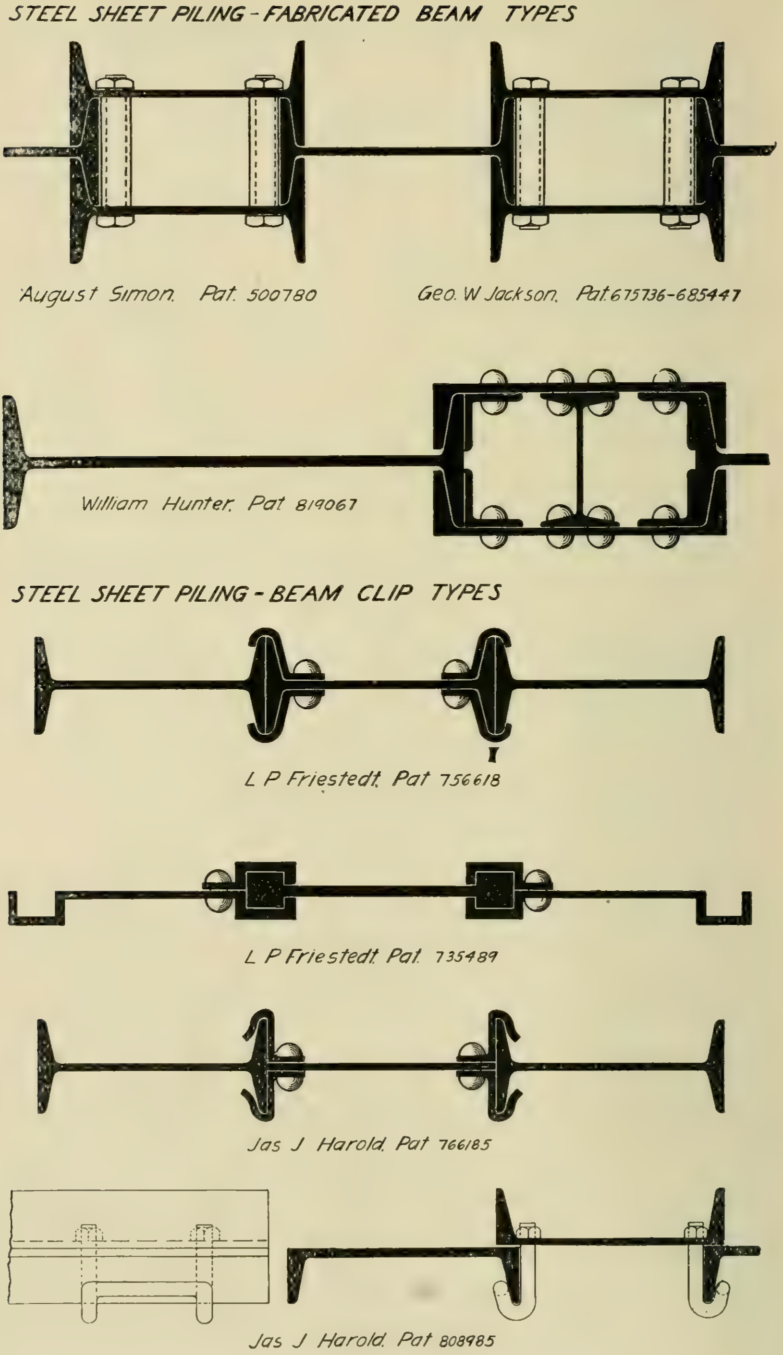

STEEL SHEET PILING - FABRICATED BEAM TYPES
August Simon. Pat. 500780
Geo. W Jackson. Pat. 675736-685447
William Hunter. Pat 819067
STEEL SHEET PILING - BEAM CLIP TYPES
L P Friestedt. Pat 756618
L P Friestedt Pat. 735489
Jas J Harold. Pat 766185
Jas J Harold. Pat 808985

Fig. 2.

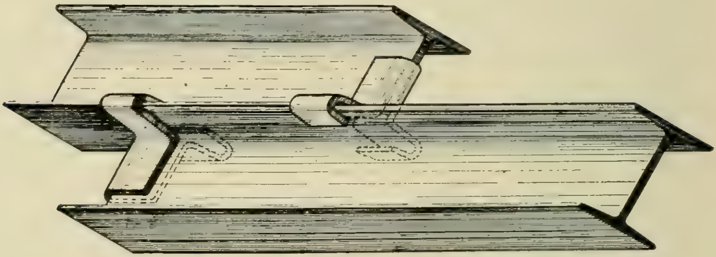
will be perfectly shut off. In brown coal mines it is very often desirable to drain the water-bearing ground on top. If this must be done, the hollow beams must only be filled with moss; after completion of the shaft and after the pumps have been definitely disposed, the moss is taken out again. By the number of beams out of which the moss is taken more or less water may be let into the shaft. It is also possible to sink the shaft in a dry state by shutting off the water for a time, and yet the moving ground can be drained afterwards." As an afterthought Mr. Simon adds: "I may state further that the described pile can be used for the construction of sluices or bridge building, water works and other foundations."

Both of these may properly be called "theoretical inventions." It was only when practical contractors saw the advantages of steel sheet piling as compared with wood that the inventions themselves were put to use in directions not originally contemplated by the inventors, and the credit for first doing so is due to the contracting firm of George W. Jackson, Inc., who drove the first steel sheet piling in November, 1901, at the Randolph Street Bridge, Chicago, constructed in accordance with the Simon patent.

The next contractor to profit by his experience in substructure construction was Mr. Luther P. Friestedt, of Chicago. He took the step which was next required in the development of the use of steel as applied to substructure construction, and claims that his invention shown in patent No. 707,837 relates to improvements in the construction of docks, wharves, sea walls, facing of sea walls, caissons, cofferdams, bulkheads and other submarine work of the same general character. Mr. Friestedt justly claims to be the pioneer of the steel sheet piling industry, and beyond question his large use of it in his own contracting work, and his efforts in the extension of the sales of Friestedt Interlocking Channel Bar Piling to others, contributed largely to make it a commercial success.

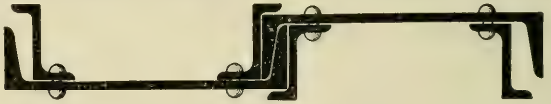
Mr. Friestedt's ideas were taken up by other contractors and inventors, and as a consequence the records of the Patent Office at Washington are replete with designs for steel sheet piling, some of which merit careful consideration, but others

## STEEL SHEET PILING - BEAM CLIP TYPES

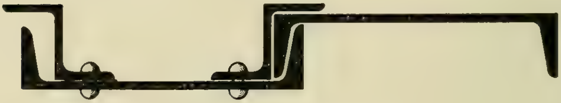


Geo E Nye

## STEEL SHEET PILING - INTERLOCKING CHANNEL BAR TYPES



L P Friestedt Pat 707837



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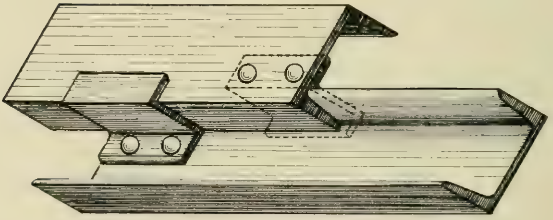
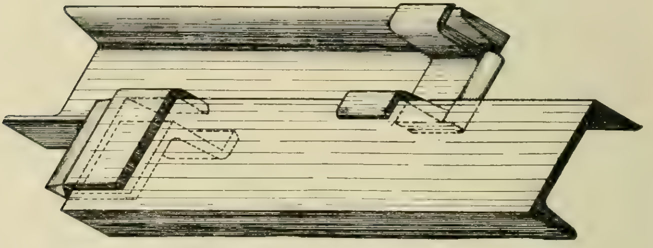


A A Friestedt



Geo E. Nye, Pat 860053

Fig. 3.

of which are absolutely impracticable. Successful invention must necessarily be accompanied by actual experience, and in case of special sections, technical ideas can only be checked in the light of rolling mill practice.

Various types of steel sheet piling have been thoroughly discussed by the present speaker before the Engineers' Society of Western Pennsylvania, and reference may be made for full particulars to the proceedings of that Society, Volume 24, No. 1, for February, 1908. The cuts show very clearly the make-up of the particular sections, and it will be sufficient to say in this connection that up to the present time none of these types have been tried in actual use except the Simon Fabricated Beam type exploited by George W. Jackson, Inc.; the Interlocking Channel Bar Piling in its Full Length, Clip Interlock and Fargo form and in the George E. Nye Clip form; the Interlocking Beam Clip type manufactured by George W. Jackson, Inc., under Patent No. 878,773, granted to Manley W. Cluxton; Corrugated Interlock type sold by the Wemlinger Steel Piling Company under the patents of Lester G. Gifford and R. V. Sage; Vanderkloot Piling and United States Steel Sheet Piling manufactured under the patents of Samuel K. Behrend.

These various types have their distinct peculiarities, advantages and disadvantages, and it may be well for us to discuss the principles which should govern the engineer in the choice of a steel piling suitable for the requirements of actual service. These principles are the same as those which would ordinarily guide a man in the choice of any other tool.

First, the ideal steel piling must possess strength, and inventors of what may be called "composite steel piling," where both wood and steel are employed in the same structure, have overlooked the fact that the strength of a member is the strength of its weakest part, and that the Scriptural prohibition not to plow with an ox and an ass hitched together is sound advice in building construction. Strength in cofferdam construction is intimately connected with the whole subject of bracing, which has not yet been reduced to scientific form. Sheets of paper can be used to hold in place small piles of sand, but thin sheets of steel can only be economically used where the depth is not

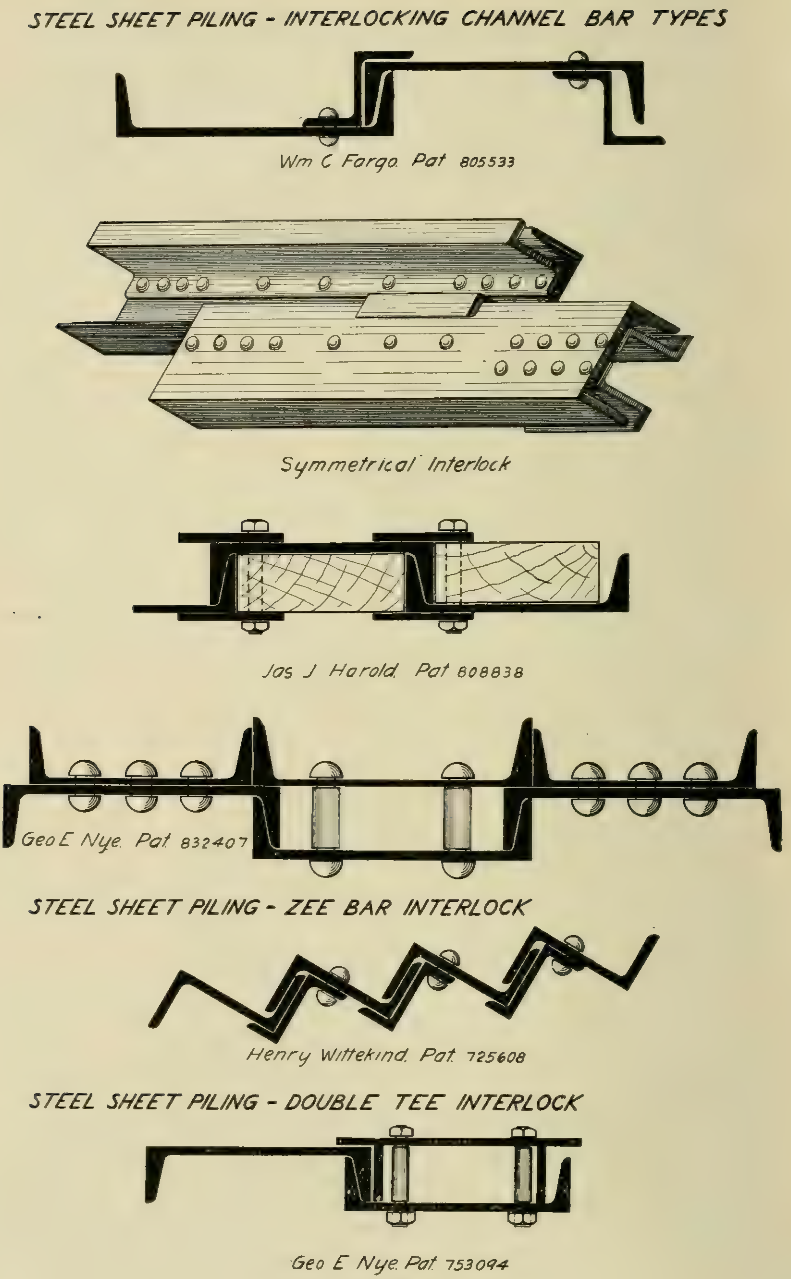

STEEL SHEET PILING - INTERLOCKING CHANNEL BAR TYPES
Wm C Fargo. Pat 805533
Symmetrical Interlock
Jas J Harold. Pat 808838
Geo E Nye. Pat 832407
STEEL SHEET PILING - ZEE BAR INTERLOCK
Henry Wittekind. Pat. 725608
STEEL SHEET PILING - DOUBLE TEE INTERLOCK
Geo E Nye. Pat 753094

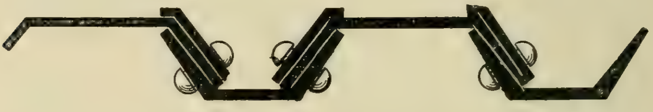
Fig. 4.

great and where the soil is loose; and yet there are inventors who gravely advocate the use of practically plain sheets of steel ⅛″ thick, and claim that they can be driven more easily and correctly than 4″ tongue and groove plank in any possible soil from quicksand to hardpan, will not sustain any injury or distortion in driving, and may be pulled and used over and over again. In the case of this piling, the piling itself has to be driven with a special wood follower which is removed after the driving of each piece. This, however, vitiates the fundamental idea of steel sheet piling. If it is necessary to splinter, batter and destroy a large lot of timber in order to get sheets of steel into position, the question arises, why is the steel necessary, and why not revert to our original wood construction? It is useless to use material too light for work that engineering calculation finds necessary from the use of approved formulas; one advantage of steel is that it can be furnished in any weight or thickness desired.

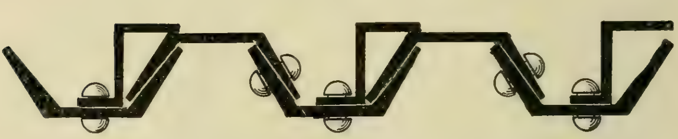
Steel sheet piling should be braced with judgment, and it is better to put our trust in good strong bracing than to take chances of serious failure, not because the sheet piling itself would be destroyed by almost any conceivable failure, but because of the delays and expenditures incident thereto due to the lack of that judgment which is necessary in the use of all the materials of engineering construction. It is pretty clearly made out that under ordinary conditions a 33 lb. or 35 lb. piling can be driven through almost any class of material up to 35 feet; and that a 38 lb. or 40 lb. piling can be driven and successfully withstand, with proper interior bracing, up to 50 feet. It has also been proven by experience that if a lighter weight material is to be driven to these depths, it can only be done at the risk of failure, or by the use of such an amount of bracing as would not be economical. Some types of piling can be used with perfect success for light work. There are other conditions where the heaviest, strongest, stiffest material is required, but any condition can be successfully met by the use of the ordinary formulas for the flexure of beams taken in connection with the properties of the section interlocked.

The strength of the material when interlocked in position

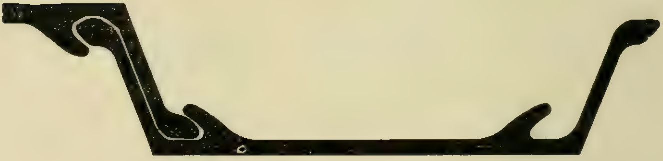
## STEEL SHEET PILING – INTERLOCKING TROUGH PLATE TYPES



Frank Kneas, Pat. 744361

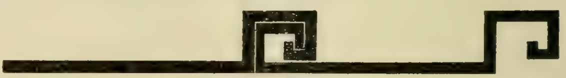


Walter L. Cowles & Jas. N. Hatch, Pat. 751469



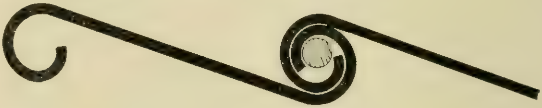
Julius R. Wemlinger, Pat. 801946

## STEEL SHEET PILING – BOX INTERLOCK



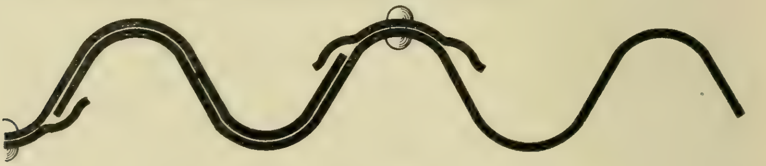
Geo. W. Jackson, Pat. 697943

## STEEL SHEET PILING – SCROLL INTERLOCK



R. H. Stevens, Pat. 824513

## STEEL SHEET PILING – CORRUGATED INTERLOCK



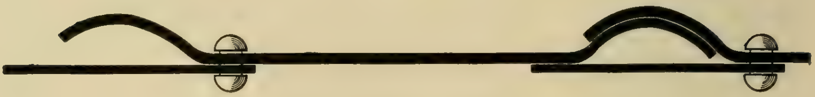
Lester G. Gifford & R. V. Sage, Pat. 766132

Fig. 5.

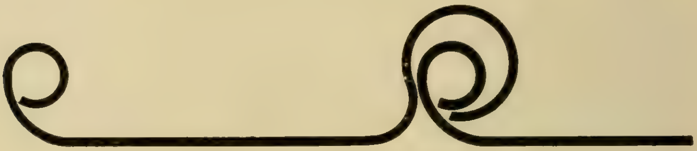
may be different from its strength during driving, just as along the lines of ordinary building construction in which final stresses may vary from erection stresses, and the careful engineer will, therefore, select a material with a large radius of gyration and section modulus of the single pile. The construction of the piling should be such as to properly distribute the blow of the pile driving hammer; and if material is to be pulled and re-used, the tops must be protected from battering. This point is illustrated by the history of the Friestedt piling. Under the difficult conditions encountered by Mr. Wm. G. Fargo in driving piling for the Grand Rapids Muskegon Dam through sand, clay, gravel, boulders, etc., he discovered that the plain channel is only about one-fourth as strong as its adjoining member with two zee bars riveted thereon. Consequently, he took the next step forward, which was to rivet a single zee bar on each channel, making both pieces approximately of the same strength. This made the pile more free to move in the interlock, but the straightness of alignment was interfered with. Moreover, the weight of the pile driving hammer was not equally distributed on the pile itself, the edge carrying the zee bar being more able to resist the blow. The addition of a short zee bar on the other side, shown in the symmetrical interlock type, gives a section that is perfectly symmetrical, and in which the blow of the pile driving hammer is equally distributed over the head of the pile, and in which a high degree of stiffness under driving has been obtained. This form of piling, therefore, probably represents the best that can be obtained in built-up sections for heavy driving.

One advantage of the United States Steel Sheet Piling, covered by Samuel K. Behrend's patent No. 639,884, issued December, 26th, 1889, consists in the fact that all sections are perfectly symmetrical, that each one is as strong as the other, and that the interlock is practically perfect. Under conditions of unequally distributed earth or water pressure it is apparent that distortion in the alignment will naturally tend to create tension in the interlock, and that there should be sufficient material here to take care of all such stress. Strength in the interlock, stiffness in driving and strength when interlocked are requirements which are indispensable in the use of steel piling.

## STEEL SHEET PILING - SPRING LOCK INTERLOCK

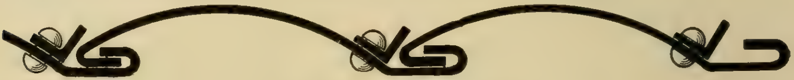


Frank W. Skinner. Pat 863886



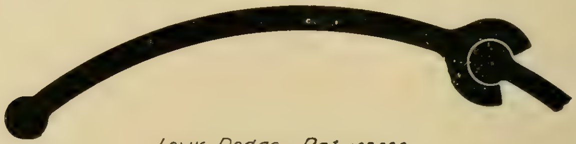
J. R. Williams. Pat. 838152

## STEEL SHEET PILING - CAMBER PLATE INTERLOCK

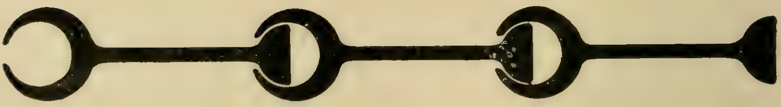


F. Lang - Camber Plate.

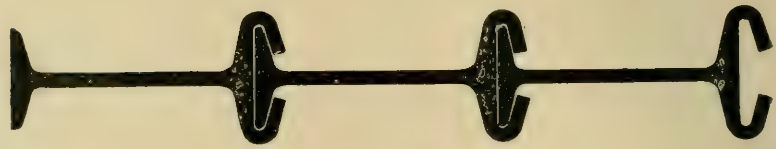
## STEEL SHEET PILING - SPECIALLY ROLLED TYPES



Lewis Dodge. Pat 103028



Samuel K. Behrend. Pat 639884



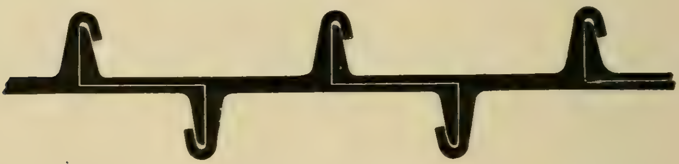
W. C. Harder. Pat 771426

Fig. 6.

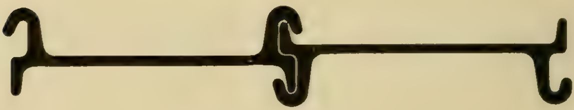
The next requirement to be considered is that of economy, and here there are two features which enter into the discussion; the one, that of direct comparison with the cost of wood; and the other, comparison of forms of steel piling among themselves, some forms being more economical from a rolling mill standpoint than others. As regards the first point, it may be said that owing to the rapid denudation of our forests and the exhausting of resources once considered inexhaustible, the element of economy is not so much a question as when the use of steel sheet piling was first proposed. At the close of 1906 Hemlock lumber cost just twice what it did in 1897; White Oak 39 per cent more; White Pine 88 per cent more; Yellow Pine 78 per cent more; Spruce 82 per cent more; while steel has only advanced 38 per cent above the prices of that year which are recognized to-day as being about the bare cost of production. If we have to consider the first cost of a single installation, therefore, our figures would appear to-day 50 per cent or more better than when the originators of the steel piling industry first began to market their wares. Since steel piling has been placed on the market its increasing use in all types of structure and under varied conditions of driving demonstrates that its simplicity, the convenience with which it may be obtained, its watertightness without puddling, the ability to draw and to reuse it repeatedly have made it more economical than wood in ordinary coffer construction, and has also demonstrated that it can be economically used where wood is absolutely out of the question.

As to the second point, the economy of forms of steel piling among themselves, it may be said briefly that that piling is more economical for ordinary purposes whose strength is high in proportion to its weight. A form of piling which requires special rolling mill equipment, and whose manufacture is attained only at a high rolling cost, is obviously barred from commercial uses. The fact that certain forms of steel piling can be built up from structural material obtainable from any of our good rolling mills, or accessible in the warehouses scattered over our lands, is a very large item in their favor. Intricate interlocking systems, dove tailed and reversely bent forms cannot long merit consideration.

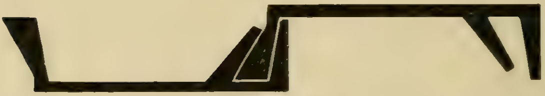
## TEEL SHEET PILING - SPECIALLY ROLLED TYPES



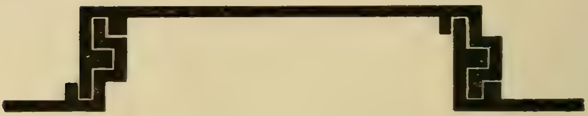
Mathias R Vanderkloot. Pat 786329



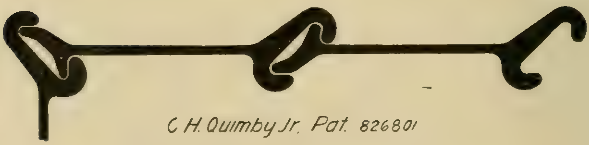
Vanderkloot Piling as rolled



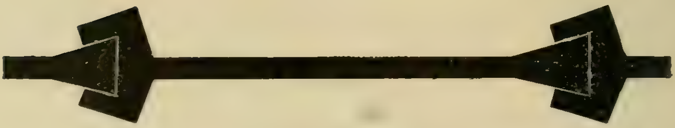
R. Dobry. Pat 778354



Geo. E Nye. Pat 782872



C H. Quimby Jr. Pat. 826801



J J Nolty, Pat. 829596

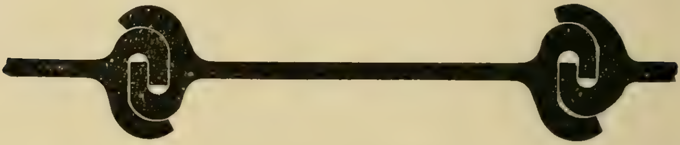
Fig. 7.

The economical section should also be a section easy to drive; looseness in the interlock is here indispensable; material should go down easily, should be drawn easily; and there are sections illustrated in the cuts which have been rolled and put on the market, but have fallen by the wayside by reason of failure to meet this necessary condition.

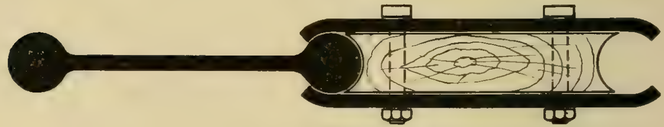
The next requirement to be considered for subaqueous foundation work especially is its watertightness. In the wooden cofferdam, as is well known, it is almost impossible to attain this feature, and it is by reason of this difficulty, in part, that the wooden cofferdam has to be constructed with double walls puddled between. It is very apparent that if one of these walls may be eliminated by the use of steel, a great gain in economy of construction has been accomplished. The best types of steel sheet piling are practically waterproof under ordinary conditions of driving. The Friestedt Interlock Channel Bar Piling resists water pressure remarkably well, the fine particles of silt, gravel, etc., which are carried into the interlock forming a water seal; and if, perchance, on unwatering leaks should develop, they may very easily be stopped by the application of silt to the outside surface or by the use of oakum or other packing material on the inside. United States Steel Sheet Piling is practically watertight also; it can be made completely so by the driving down with the piling of wooden packing strips in the interlock; these wooden packing strips swell under water, thus effectually sealing the opening. It might be supposed that the driving of these wooden packing strips would make the material go down with more difficulty; this, however, is not the case, as the wood acts more or less in the same way as a lubricant.

Steel sheet piling is driven just as wooden sheet piling, with a drop hammer or with the ordinary pile driving steam hammers, the only additional equipment necessary being the use of a special follower cap to go down with the piling to prevent its tops from being battered. When the piling is to remain in permanent position, this is not necessary, though its use may be desirable in view of the fact that the material encountered may require occasional piles to be pulled and re-driven. Photograph No. 34 shows a pile driving hammer and cushion hood

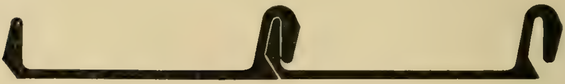
STEEL SHEET PILING - SPECIALLY ROLLED TYPES



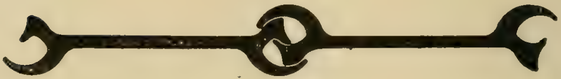
Truman Hill Pat. 829399



F R Dravo. Pat. 863837



J. R Williams, Pat. 836792



Conkling Model

Fig. 8.

used in the driving of 12″ 40 lb. United States Steel Sheet Piling at Dam No. 3, Allegheny River.

The steel piling must be reliable. The contractor who buys it as part of his regular equipment must statisfy himself in its puchase just as he uses that ordinary care in the purchase of any other tool. The ideal piling for his purposes is economical from the standpoint of manufacture, is easy to drive, is stiff in the driving, is easy to pull, and when driven is perfectly watertight. Whether or not any piling under consideration meets these requirements can be decided from the experience of their users, for reliability is a result of experience, not of theoretical considerations, and reliability is also a criterion of fitness. We have seen that wooden sheet piling has proved its unreliability under any but the most favorable conditions; we have seen that cast iron sheet piling proved itself a failure under conditions of use in England; we have seen that steel cofferdams of fabricated boiler plate construction, such as used in the Firth of Forth bridge, are only economical when becoming part of the structure. Can we say to-day that steel sheet piling is a reliable tool, and if reliable, which one of the forms discussed have the highest claims for consideration?

A small quantity of piling has been manufactured and driven by George W. Jackson, Inc., under the Simon patent for use in the contracting operations of this firm, but it is only fair to say, however, that up to the present time the only types which have really been tried out in all classes of construction and under the most favorable, as well as the most unfavorable, conditions of driving have been Friestedt Interlocking Channel Bar Piling and the United States Steel Sheet Piling.

The first Friestedt Interlocking Channel Bar Piling was driven in October, 1902, and previous to January 1st, 1907, some 10,000 or 12,000 tons of it were in successful use. 2,941 tons of it were sold during the year 1907. United States Steel Sheet Piling was first successfully rolled on December 23rd, 1904, and the record of its sales is a record of the growth of the steel piling industry as well as of the utility of the tool in question:

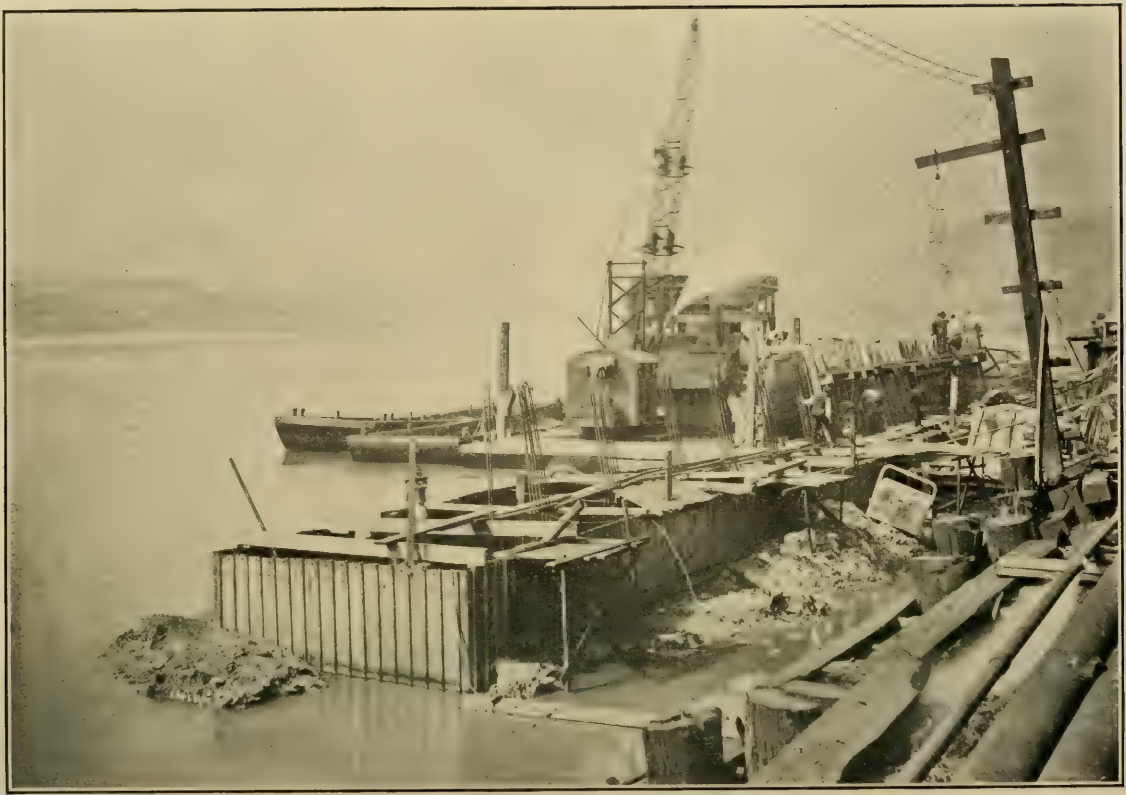


Fig. 9—Cofferdam for Concrete River Wall at Pennsylvania Works,
National Tube Company, Pittsburg, Pa.

| | | |
|---|---|---|
| 1904 | 80 | tons |
| 1905 | 1,152 | " |
| 1906 | 3,971 | " |
| 1907 | 9,389 | " |

It might be interesting to note the types of construction in which this piling has been used—circular walls, cofferdams, core walls for dams, crib construction, culverts, building foundations, foundry curbing, loading slip, dock reinforcement, reservoirs, retaining walls, sea walls, sewers and sub-ways.

The distribution of the tonnage sold during 1907 is proof of the possibilities and capabilities of this class of tools. 138 tons went to Canada for cofferdam construction and lock work. 128 tons to Cape Town, South Africa, for temporary trench work in connection with the Selborne Dry Dock at Simonstown. 90 tons to Mexico. 653 tons to Brazil. 446 tons to the Municipality of Singapore, Straits Settlement, for construction of the Kalang reservoir, steel piling being chosen for the purpose after very careful tests with other material. 207 tons to England for the re-construction, principally, of the Buccleuch Dock, Barrow-in-Furness. 138 tons to the Argentine Government. 286 tons to the railroad controlling bureau of Corea at Chemulpo. While 1,203 tons were used in the various reclamation projects and river and harbor improvements of the United States Government, which is in itself a sufficient commendation of the usefulness of the tools in question. It may also be mentioned as a matter of interest that in 1908 233 tons of United States Steel Piling were sold to the Mexican Government for use in the construction of the Independence Monument, City of Mexico; while a considerable tonnage has been purchased by the Isthmian Canal Commission for cofferdam work in the canal zone.

The illustrations of its use which we have now to present are but samples of the large number available for that purpose, and the usefulness of steel sheet piling as a part of the contractor's regular equipment is thereby abundantly demonstrated.

Figure 9 shows United States Steel Sheet Piling cofferdam used at the Pennsylvania Department, National Tube Com-

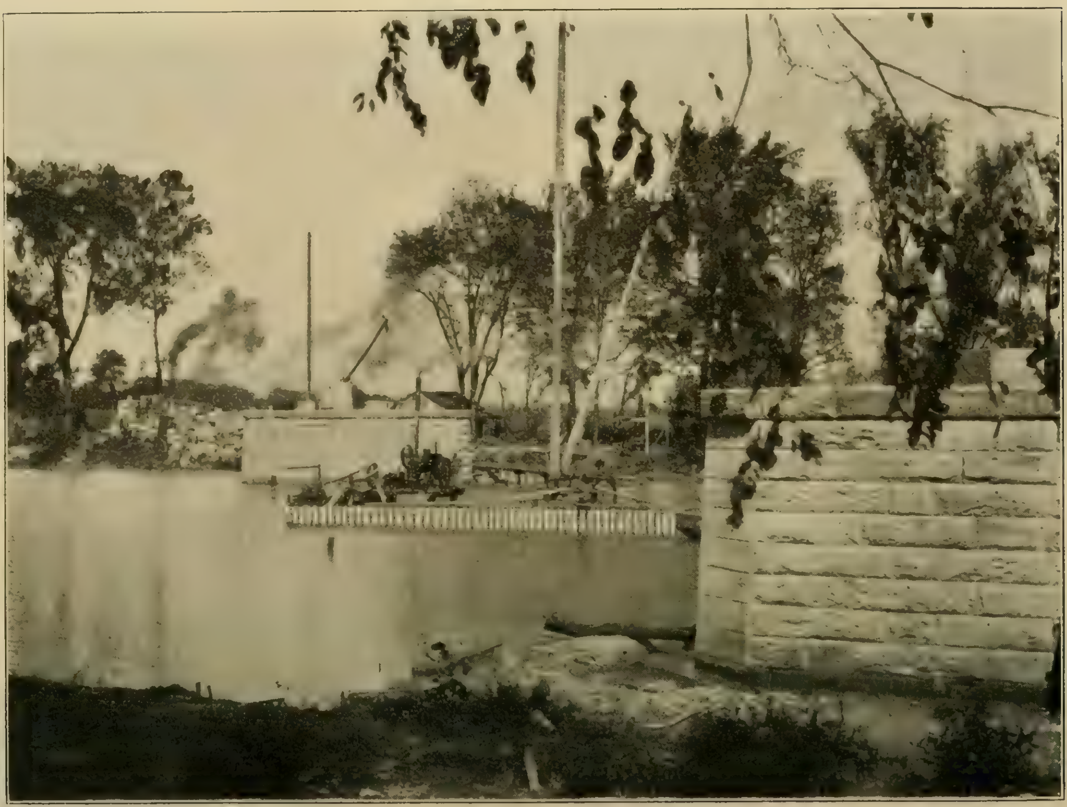


Fig. 10—Cofferdam Norfolk & Western Railway Bridge, Scioto River, Chillicothe, Ohio.

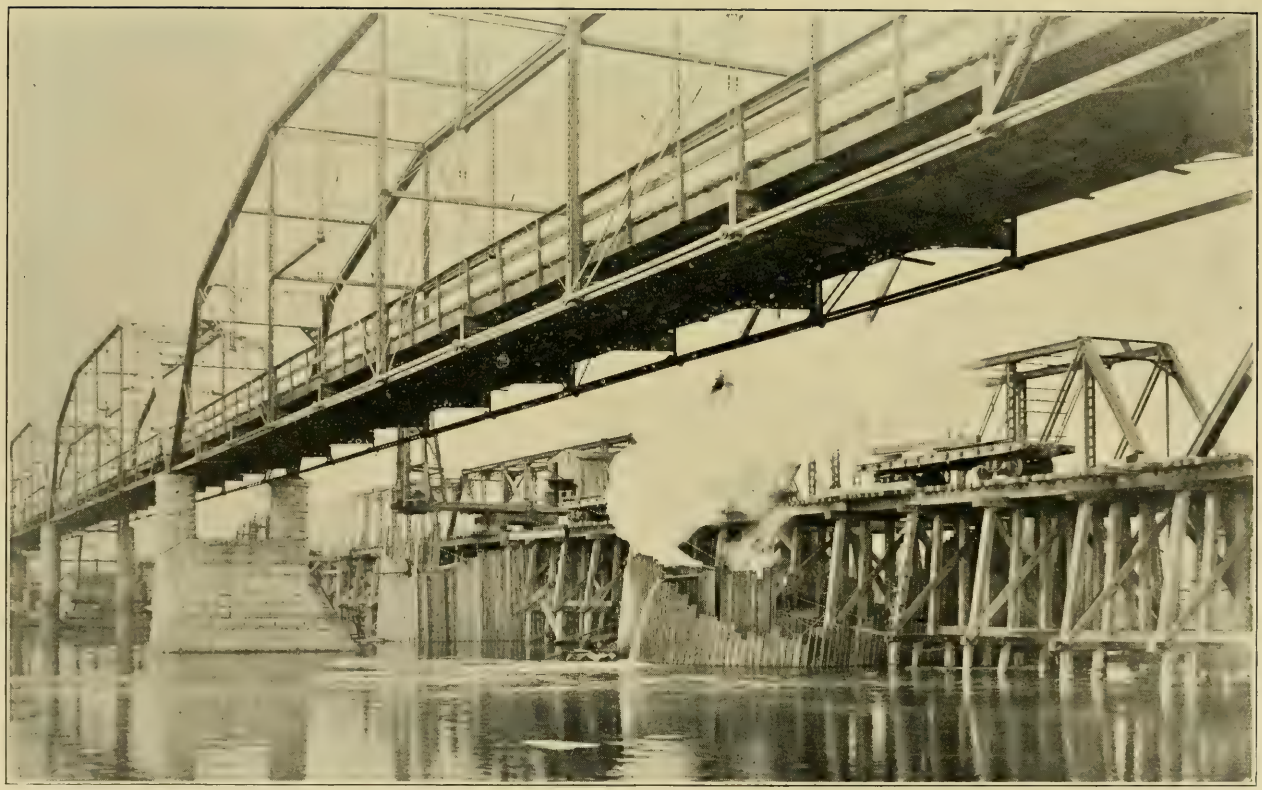


Fig. 11—Cofferdam Mississippi River Bridge, Chicago & Northwestern Railway Company, Clinton, Iowa.

pany, 22nd Street, City. It is for the construction of a river retaining wall. The 12" 35 lb. sections were used in 18 and 24 foot lengths, and were pulled and re-driven eight and four times respectively. A 3000 lb. steam hammer drove a maximum of 102 pieces a day. Material in the river bed contained sufficient loose sand and gravel to make the cofferdam practically watertight without packing strips.

Figure 10 shows the general arrangement of a set of steel cofferdams used in the construction of the Norfolk & Western Railway bridge over the Scioto River near Chillicothe, Ohio; while Photograph No. 4 shows the detail of one of the cofferdams, the tightness of which is to be seen in the dryness of the material around the workman's feet. This same cofferdam is an illustration of the economy of this material as compared with wood. Twenty years ago the contract cost of wood cofferdams for the old bridge, about 300 feet away, was $452.50 per structure, equivalent to-day to about $638.00 on account of the increased cost of lumber. The steel piling was purchased for one cofferdam and re-used five times, and it made the cost per cofferdam, on the basis of usual values for steel scrap, $396.00 each. As a matter of fact, this piling was later used by the Baltimore & Ohio Railroad Company in building another structure.

Photograph No. 79 shows Friestedt Steel Piling used in the construction of cofferdam for the Missouri, Kansas & Texas Railway at Eufaula, Indian Territory.

Photograph No. 156 shows part of an installation of 176 tons of 12" 40 lb. United States Steel Sheet Piling used to form a cofferdam for the Southern Wisconsin Power Company at Kilbourne, Wisconsin; while Photograph No. 157 shows the driving arrangements. Sections were driven by a one ton drop hammer at a cost of about 10 cents per foot. No packing strips were used, and a 1400 gallon centrifugal pump kept the excavation dry.

Photograph No. 170 shows United States Steel Sheet Piling driven to form a cofferdam for the United States Reclamation Dam at Whalen, Wyoming; and it may be said here that the

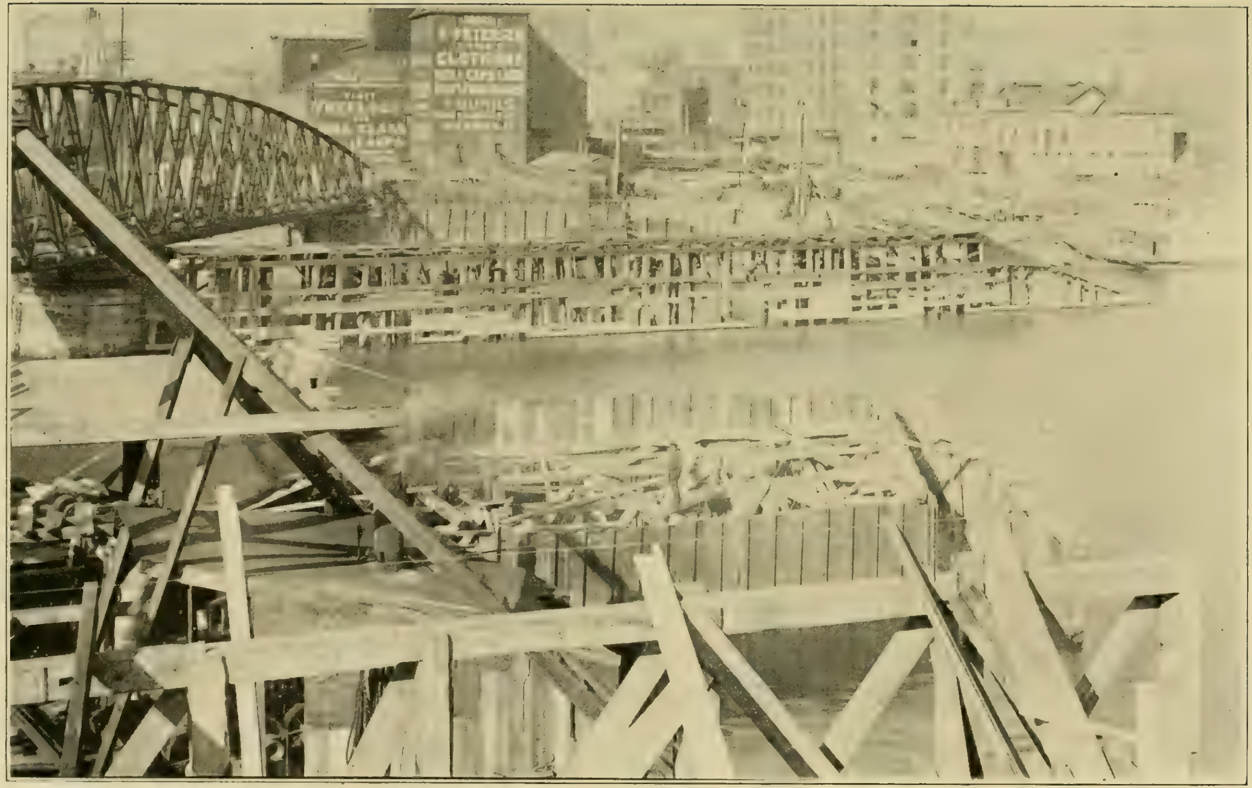


Fig. 12—Cofferdam Peoria City Bridge, Peoria, Ill.

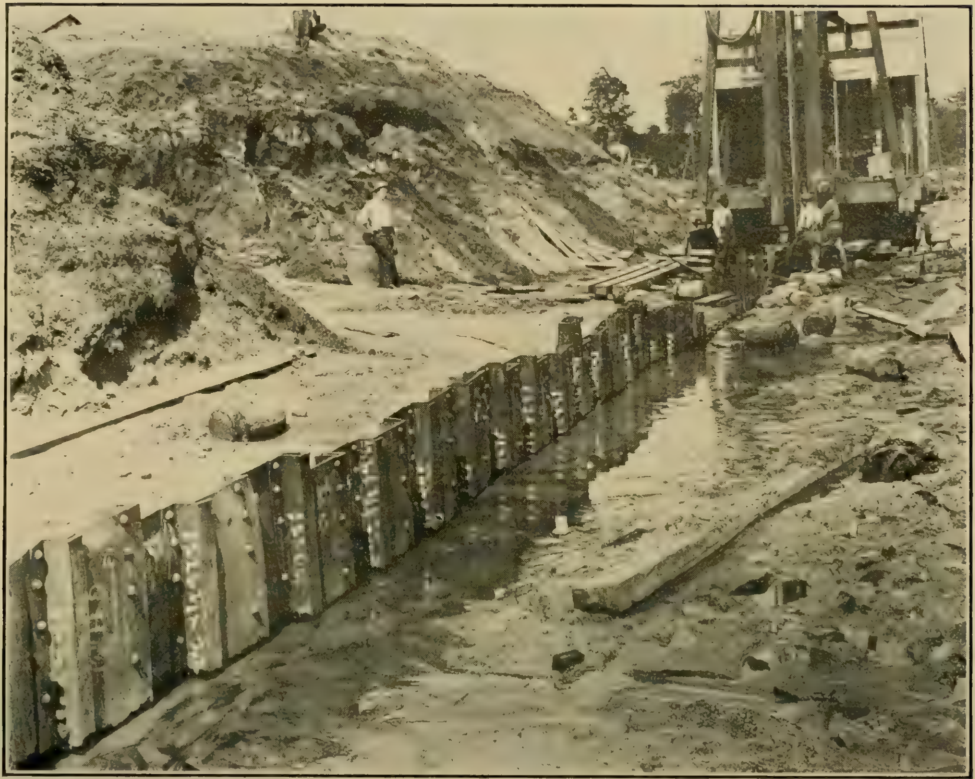


Fig. 13—Dam for Berrien Springs Power Company, Berrien Springs, Mich. Steel Piling Core Wall.

United States Reclamation Service has used both forms of steel sheet piling in numerous installations: at Belle Fourche, South Dakota; the Avalon Dam, Carlsbad, New Mexico; the Truckee-Carson Dam, Derby, Nevada, etc.

Figure 11 shows two of the nine piers for the new bridge being built by the Chicago & Northwestern Railroad across the Mississippi River at Clinton, Iowa, in which 1,160 tons of United States Steel Sheet Piling, 12″ 40 lbs., were used in 30 and 40 foot lengths to form cofferdams 14 feet wide by 60 feet long. Material was bought for three cofferdams only; the piling was pulled and re-driven twice each for the remainder at an average cost of about 18 cents per foot. In the near pier it will be noted that two lines of steel piling has been used after the fashion of ordinary wooden cofferdam construction. The engineers speedily found, however, that a single wall of steel piling was amply sufficient, and that the few leaks could easily be taken care of by a 500 gallon Centrifugal pump.

Figure 12 shows one of five cofferdams constructed for the new city bridge at Peoria, Illinois, by the Marsh Bridge Company. The cofferdams were 42 x 72 feet, and 130 tons of Friestedt Piling was furnished in 30 ft. lengths for one structure. It was pulled and re-driven five times, and it is interesting to note that the material in question was purchased second-hand from another contractor who had already used it twice previously. Cost of driving was about 14½ cents per foot, and the few leaks were taken care of with a 500 gallon pump.

Photograph No. 35 shows part of a cofferdam for Lock No. 1 on the Lachine Canal, near Montreal, Canada, and it will be noted how well the piling has withstood the process of driving.

Photograph No. 163 illustrates an intake constructed by the Wickwire Steel Company at Rattlesnake Island, Niagara River. Material was driven without packing strips, but was caulked by back filling. It will be re-used six or eight times in digging trench for water main 700 feet long. This was 12″ 35 lb. United States Steel Sheet Piling 16 feet long.

These are all illustrations of installations in which steel has replaced wooden sheet piling.

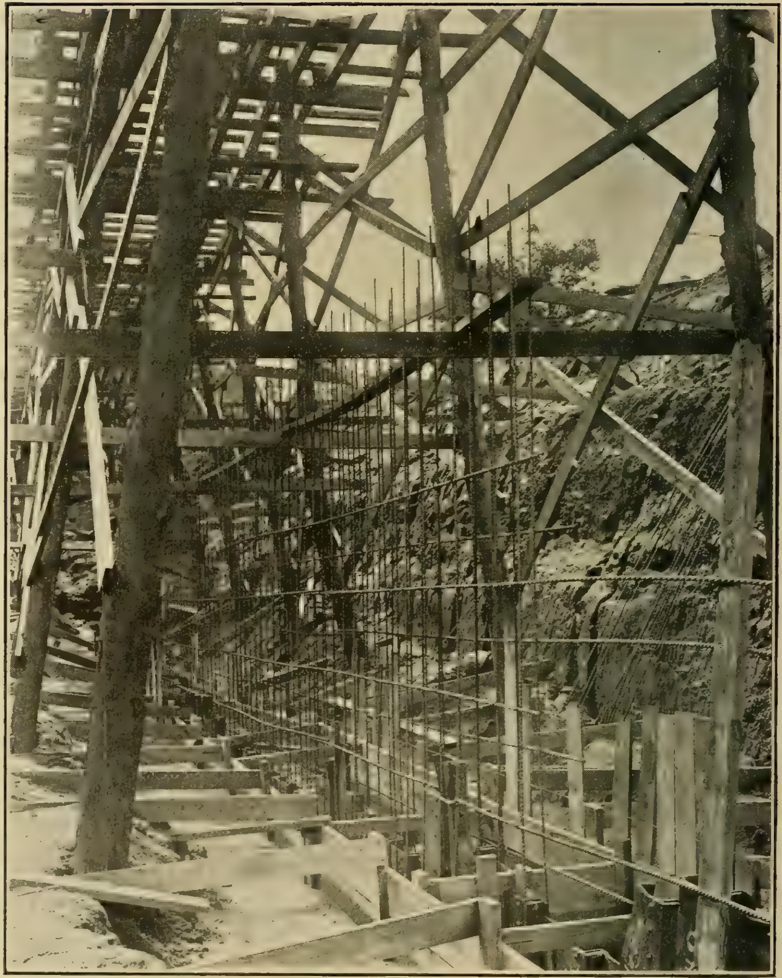


Fig. 14—Dam for Berrien Springs Power Company, Berrien Springs, Mich. General View.

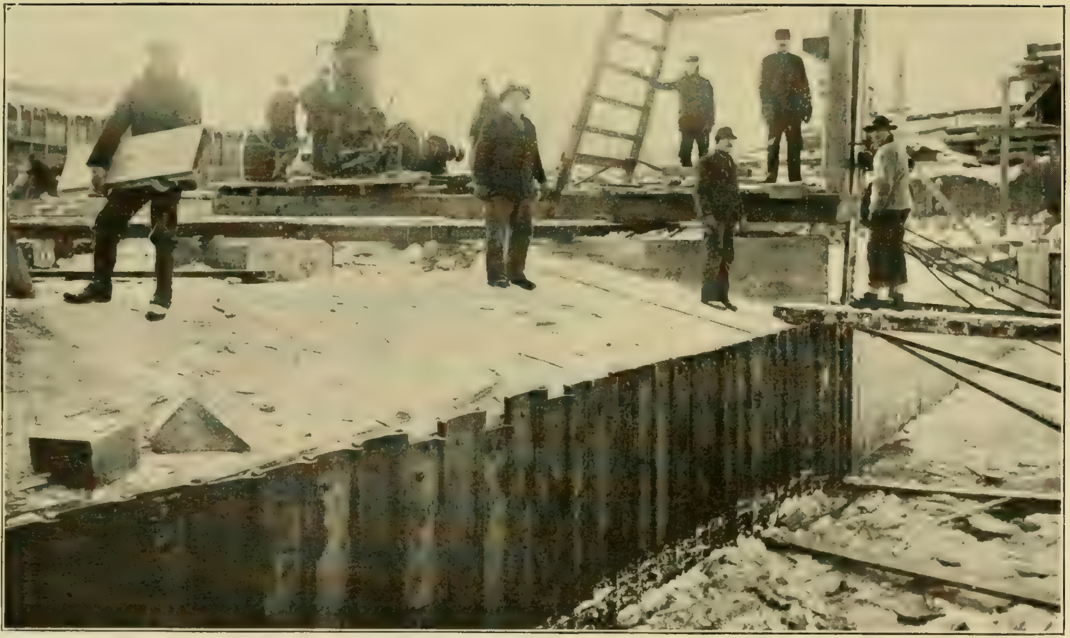


Fig. 15—Dam for Watab Pulp & Paper Company, Sartell, Minn.
Steel Piling Curtain Wall.

With Figure 13 we pass to a different line of structures, viz., the construction of a permanent core wall for earth filled dams. This type of dam is itself recent, and steel sheet piling is proving itself invaluable for the purpose intended. The photograph shows a general view of the dam at Berrien Springs Power & Electric Company at Berrien Springs, Mich., where about 30 feet of excavation and concrete was saved by the use of Friestdet Interlocking Channel Bar Piling, at a driving cost of from 7¼ cents to 20 cents per foot. The driving in this instance was through sand, gravel and boulders in an eroded river valley under quite difficult conditions. The tops of the piling appear a little bit battered, which could have been prevented by the use of a single short zee provided in the symmetrical interlock type of steel piling. As this material remained permanently in position, and was, therefore, not to be pulled, the battering of the tops made no material difference.

Figure 14 is a general view of the same structure showing steel reinforcing bars in place, the forms for concreting and the service tracks on the trestle overhead.

Figure 15 shows a steel core wall for the dam of the Watab Pulp & Paper Company at Sartell, Minn., and the regularity of driving is plainly apparent. The steel piling in question was first used in the construction of the cofferdams for the river portion of the walls, and afterwards placed in permanent position as shown. It may be noted that the steel piling was pulled and re-driven in freezing February weather with the thermometer 30 degrees below zero.

Photograph No. 32 gives a set of views of Dam No. 2 at Aspinwall, Pa. It will be recalled that in January, 1907, both dams No. 2 and No. 3 were undermined by the high waters, and that at Dam No. 3 especially the banks were also undermined, houses and railroad tracks carried off and the dams seriously damaged, partly due to the use of dynamite to prevent further damage to the banks and the property thereon. Steel sheet piling was driven along the upper face of the dam and along the faces of the wing wall to prevent further underscour.

Photograph No. 28 shows Dam No. 3 with the piling in

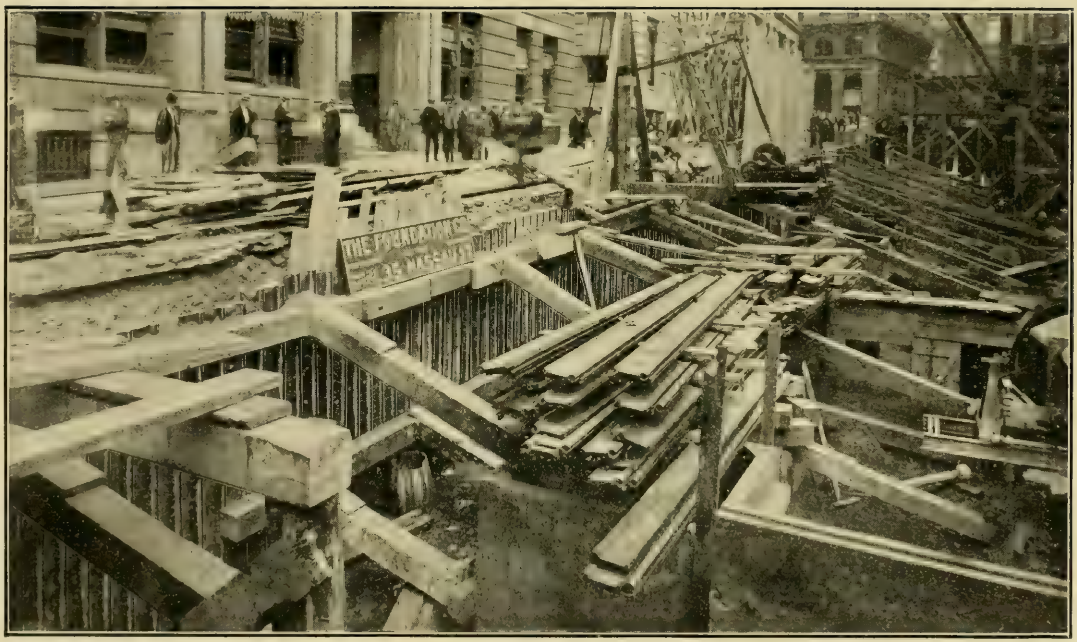


Fig. 16—Trinity Building, New York City. Permanent Steel Piling Retaining Wall.

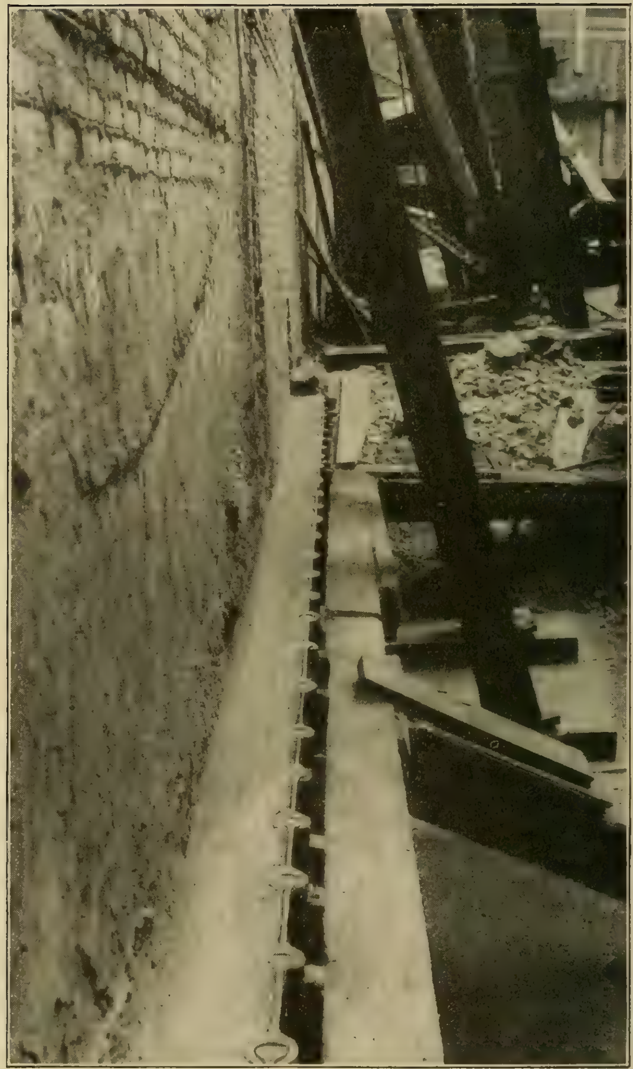


Fig. 17—Tribune Building, New York City. Permanent Steel Piling Retaining Wall.

position for the revetment of the river banks, the space between the line of piling and the shore being filled with stone and riprap for permanent protection.

With Figure 16 we reach another class of structures, viz., retaining walls, and we have here 12" 35 lb. United States Steel Piling holding back the lateral pressure of the street during the excavation for the Trinity Building in New York City. Those who are familiar with operations of this sort will notice that the amount of bracing required and the size of timbers is much less than in wood construction for the same purpose.

Figure 17 shows similar construction in the preparation of the foundations for the new Tribune Building, New York City. It will be noted that 12" United States Piling was driven very close to the wall, and that the space between the piling and the old building was filled with concrete. These sections were put down on an average of about 2½ minutes.

In Photograph No. 43 we have a view of the bottom of retaining wall at the new Hoffman House, New York City, where Friestedt Piling was driven in 15 ft. to 25 ft. lengths to hold the foundation of the old portions and as caissons for the new piers. The driving was very severe, through boulders and other heavy material. The boulder shown in the left of the picture has been chipped off by one of the piling sections. This installation is particularly interesting by reason of the fact that it was necessary to maintain an uniform level at the tops of the piling, and they were, therefore, burnt off by the use of electricity.

Photograph No. 148 shows steel piling used in the construction of a loading slip at Inglis, Florida, for the Dunnellon Phosphate Company. The two lines of piling were 126 feet long and 40 feet apart, and were driven with a 1500 lb. drop hammer.

Photograph No. 150 gives a nearer view of the right hand side of this slip, while Figure 18 shows the left hand side with a part of the piling painted. It is to be noted that while the clip form of steel piling is only suitable for light driving, it was quite successfully used in this particular installation.

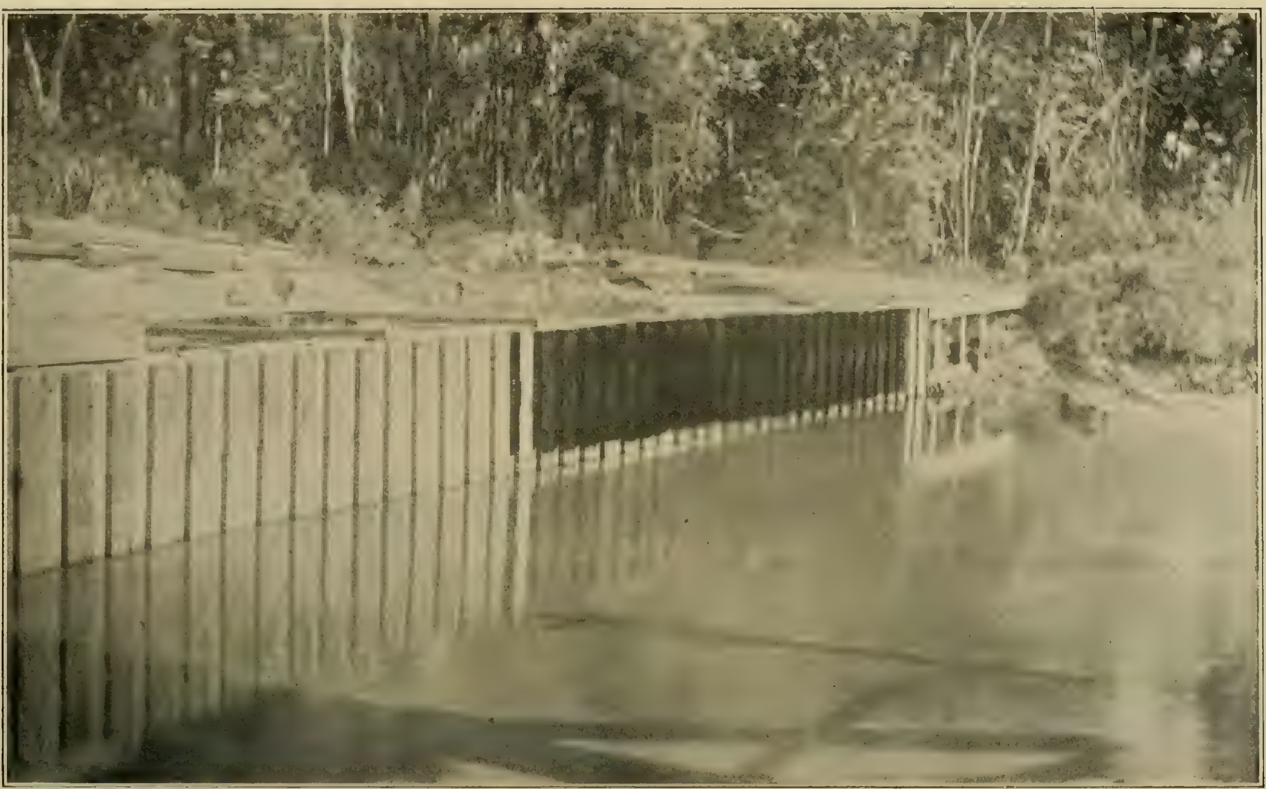


Fig. 18—Loading Slip, Dunnellon Phosphate Company, Inglis, Florida. West Wall of Slip.

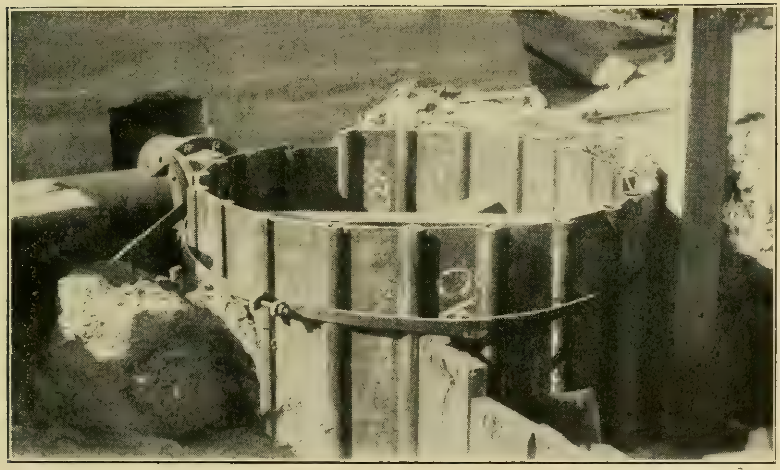


Fig. 19—Nottingham Colliery, Lehigh & Wilkes-Barre Coal Company. Circular Steel Piling Pump-Well.

If steel sheet piling can be made watertight from the infiltration of water on the outside, it is apparent that it may also be made to hold water on the inside, and Figure 19 illustrates a circular pump-well in the Nottingham Colliery of the Lehigh & Wilkes-Barre Coal Company at Plymouth, Pa. It is 6 feet in diameter and 22 feet deep, composed of 12″ 35 lb. United States Steel Sheet Piling sections which were driven with a drop hammer at a cost of about 15 cents per square foot. The band around the top was put on as an additional precaution, but has been found unnecessary in service.

With Photograph No. 74 we reach steel sheet piling used for the building of foundation piers at the Marshall Field & Company's warehouse, Chicago, Ill. The Friestedt type of piling was used, with corners of special construction in order to secure the desired dimensions, and it is apparent at a glance that in case of multiple piers ordinarily found in building, the economy of steel is beyond question.

Figure 20 shows a caisson sunk 30 feet under the east end of the Pennsylvania Railroad tunnel at Jersey City in order to construct elevator shafts in the North River tunnel of the Hudson Company. Steel piling was driven in a very limited space without interfering with the traffic above.

Photograph No. 71 shows an open portion of the same job, illustrating more clearly the bracing of this class of construction. It may be said, however, that the amount of bracing could have been very much reduced.

In Photograph No. 68 is seen a quantity of steel sheet piling driven to form a screen wall for the Edison Power Company at 201st Street and Harlem River, New York City. This is interesting in showing graphically the battering of the tops of a number of wooden piles driven just outside this structure as compared with the neat condition of the steel piling itself.

What becomes of the tools when they have served their purpose and the contractor no longer needs them? Photograph No. 196 shows that the only end of wooden sheet piling when it has passed through one or two installations is entire destruction. In Photograph No. 46 we see steel sheet piling after it

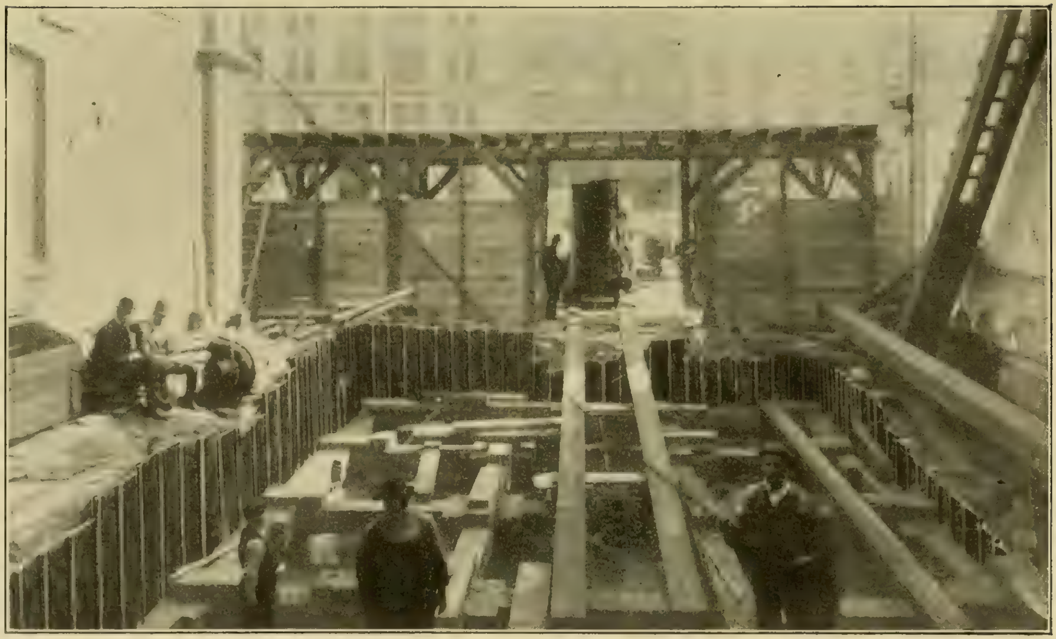


Fig. 20—Hudson River Tunnel, Jersey City. Elevator Shaft Passenger Entrance.

has successfully served its purpose, after it has been battered and bruised and distorted so as no longer to be available for use or resale as structural material, on its way back to the open hearth furnace to be remelted and to go through a process of transformation from which it may emerge again and again to be of repeated service to man in the construction of the highest products of the most advanced civilization.

This paper has been devoted exclusively to new uses for steel, primarily in subaqueaus foundation structures. There has come recently another very important new use for steel in the replacement of wood in mine operations, and if it is the pleasure of the Railway Club of Pittsburgh to hear a discussion along this line of commercial attainment, the speaker will be glad to enter upon it at some later convenient season.

Note.—The lecture was illustrated by lantern slides; only part of the photographs are reproduced.

VICE PRESIDENT: The subject is now open for discussion. There may be some engineers in the room who would like to ask some questions, and I am sure the speaker will be glad to answer any questions that may be put to him.

Mr. Whited is in the room, may be hear from him?

MR. WILLIS WHITED: There are many ways in subaqueous work where timber is hardly applicable. It is rather uncertain in its use. In driving sheet piling, if there are boulders or hard gravel or hardpan or anything of that kind, the piles are apt to be broken in driving, and then the next one does not go where you want it. Another advantage of steel sheet piling is that it can be driven through material that nothing else can be driven through, and it can be driven to a depth sufficient to shut off the inflow of water from an excavation. For instance, on the Monongahela River there is a layer some 34′ thick just overlying the shale that is as hard as any gravel. It is almost impossible to drive good sheet piling through, but steel sheet piling can be driven right through into the shale and cut off almost all the leakage into the dam, so that it is quite possible to lay concrete dry in the bed of the river—or practically dry. And that has actually been done on the shore of the Monongahela River at the Pennsylvania Tube Works by the Dravo Contracting Company. They are using a great deal of this United States sheet piling. It is quite expensive, and if there are only one or two piers to put in, or one or two pieces of work, so you can only use it once or twice, it hardly pays to use it unless you can sell it again for somewhere near what it costs. But if you have a chance to use it several times over it is a good deal cheaper than wood and far more reliable and much more economical. I would like to ask the speaker about how much the material costs?

MR. WOODWORTH: The price is somewhere along 2c or 2 1-10.

MR. WHITED: I have never used any of this in any of my work, but I have seen it used by my neighbors, so to speak, and they like it very much indeed. As I understand it, with ordinary care in driving, the waste is something like 5 or 6 or possibly 10%, according to the bottom you have got to drive in and the general difficulty of the work. On quite difficult work it is not over 5 or 10%. Of course, if it costs 2c or 2¼ per pound delivered, the scrap is worth something when you have no further use for it; but it is very seldom spoiled so that it cannot be used again.

MR. J. C. WARNE: In thinking over this subject some of us remember a lecture some years ago on a reinforced concrete piling to take the place of wood I do not think the speaker touched upon that form of piling at all. I would like to know if that has ever been brought to a satisfactory issue or used extensively. At that time it seemed to be a good thing.

MR. WOODWORTH: The speaker did not, of course, touch on all the attempts that have been made in piling. A concrete pile is very successfully driven in the round form, a number of forms of which are on the market. It has also been driven to some extent in the reinforced concrete type more in the line of sheet piling.

MR. WARNE: Do you know to what extent it has been used?

MR. WOODWORTH: I could not say positively.

MR. WHITED: Re-inforced concrete piling is a material that is not so well adapted to sheet piling, but it is used for ordinary piling quite extensively, as I have been informed. In fact, Mr. Cummings, one of our townsmen, told me of piling that he drove at Newport News in some harbor work, where he drove the piling right straight down just the same as you would wooden piling. The reinforced concrete piling has been used a great deal, but it has always been customary to make a pack of sand cushion or timber cushion to prevent battering the concrete, but he used it without any cushion. And it drove just as well as wood, and drove in some soil where perhaps wood would not go. It is considerably more expensive than wood, so that it is perhaps not worth while to use it except in cases where the mould is very heavy and where it would decay.

There is another type of sheet piling that I have seen illustrated that the speaker did not mention at all. The only case I saw it mentioned was in a German periodical. It was just simple I beams. One I beam would be driven with its web at right angles with the wall, and the other would be of such size that the flange would fit in between the flanges of the first beam, one driven at right angles with the other. They would alternate that way, a series of ordinary I beams right along. I do not see why it would not be quite a success.

MR. WOODWORTH: I think I referred to that type of I beam piling. You will find it in the Proceedings of the Engineers' Society to which I referred, and I think it is shown on one of the slides tonight. There are two forms in which the I beam piling has been used. It has been used by George W. Jackson in Chicago in the construction of a piece of foundation work under the patents of Manley W. Cluxton. It consists of a single I beam in its simplest form with a wrought steel clip to hold the adjoining I beam in position. I understand that installation is quite successful. There is a difficulty which I see in the use of the I beam piling. Where the I beams are butted one against the other there is not formed a perfect interlock, and under ordinary rolling conditions it would be practically impossible to get the two beams down without leaving some opening between them. It would therefore be very hard to maintain a water proof wall under water pressure. It might be pretty hard to keep out fine sand under quicksand conditions. I do not think those were encountered in the Chicago work. I think that is the only place in which that type has been used.

MR. WHITED: The I beams I spoke of were different from what Mr. Woodworth speaks of. The only place I ever heard of them being used was in Germany. Just plain I beams without any clips whatever. One I beam was driven with its web at right angles with the pressure and another with its web parallel with the pressure. It was a rather small I beam driven with web at right angles to the pressure, and on the next one the flange was wide enough that it just fit in. It is not quite so near watertight as the others, but it is cheaper and is a little stiffer if you have quite a long span. I do not know that it is any better, but it is a thing that can be used in an emergency, and I do not think there is any patent on it.

VICE PRESIDENT: Mr. Woodworth, is there anything further you would care to say, in closing the discussion?

MR. WOODWORTH: No, I think not.

MR. F. T. HYNDMAN: I move a vote of thanks to Mr. Woodworth for his very interesting and able paper.

The motion, being duly seconded, was carried unanimously.

VICE PRESIDENT: Mr. Woodworth, you have the thanks of the Club for your paper.

MR. WOODWORTH: I thank the Railway Club for the opportunity of speaking to them.

VICE PRESIDENT: On account of the death of our President, it has been decided to dispense with the luncheon feature this evening.

ON MOTION, Adjourned.

# In Memoriam

## HALL WILSON WATTS

BY THE WILL OF GOD, HALL WILSON WATTS DIED
APRIL 14th, 1908, AT THE ALLEGHENY
GENERAL HOSPITAL.

Hall Wilson Watts was born September 26th, 1850, in Allegheny, Pa., at which place he received his education, graduating from the Public School with honors. After leaving school, he served his full apprenticeship as a carpenter, and in the year 1876 he entered the services of the Jones & Laughlin Steel Company in charge of the ore transfer at Manchester, where the ore for the blast furnaces was then unloaded from cars into barges and transferred via Ohio and Monongahela Rivers to the Eliza Furnaces, and later from 30th Street, P. & L. E. R. R.

In 1886 a charter was granted the Monongahela Connecting Railroad Company, and Mr. Watts was appointed Agent for the Company, which position he held, in addition to duties of Master Car Builder, until his death.

He became a Charter Member of the Railway Club of Pittsburgh November, 1901, in which he served as a member of nearly all of its important committees, and in October, 1907, was unanimously elected President of the Club.

Mr. Watts was a man beloved by his employees and business associates, and greatly respected by his employers.

He was active in church work, having been an elder in the Presbyterian Church, and Superintendent of the Sunday School for a number of years.

The various organizations with which he was connected have met with an inestimable loss, as his advice was sought for on all occasions.

We extend to his family our sincere sympathy, and, be it

Resolved, That these expressions of our loss and sympathy be spread on the minutes of the Railway Club of Pittsburgh, and a copy sent to the family of our deceased President.

FRANK McCUNE,
L. H. TURNER,
F. H. STARK,
Committee.

# In Memoriam

## RICHARD S. MERCER

The undersigned, members of the Committee appointed to draft a suitable expression of the sentiments of the Railway Club of Pittsburgh regarding the death of Mr. Richard S. Mercer, a member of the Club, respectfully suggest that the following Memorial Minute be spread upon the records of the Club:

> MR. RICHARD S. MERCER, who died on February 23rd, 1908, was long an honored member of the Railway Club of Pittsburgh, and was possessed of such admirable traits of character as won for him the warm, friendly regard of his associates. He was a man of engaging personality, bright intellect and affable demeanor. His demise is deeply mourned by a large circle of friends, and the Railway Club of Pittsburgh hereby records its keen sense of bereavement in his death and extends its sincere sympathy to his afflicted family.

GEORGE A. POST,
D. M. BRADY,
F. W. SARGENT,
Committee.

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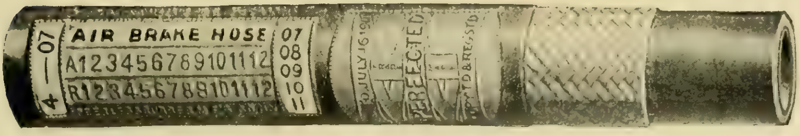

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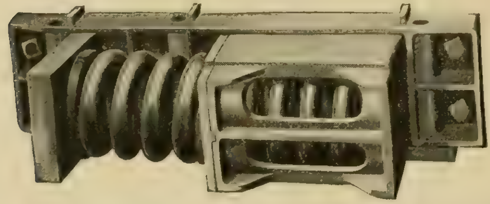

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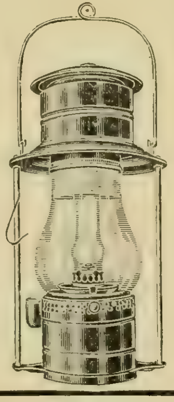

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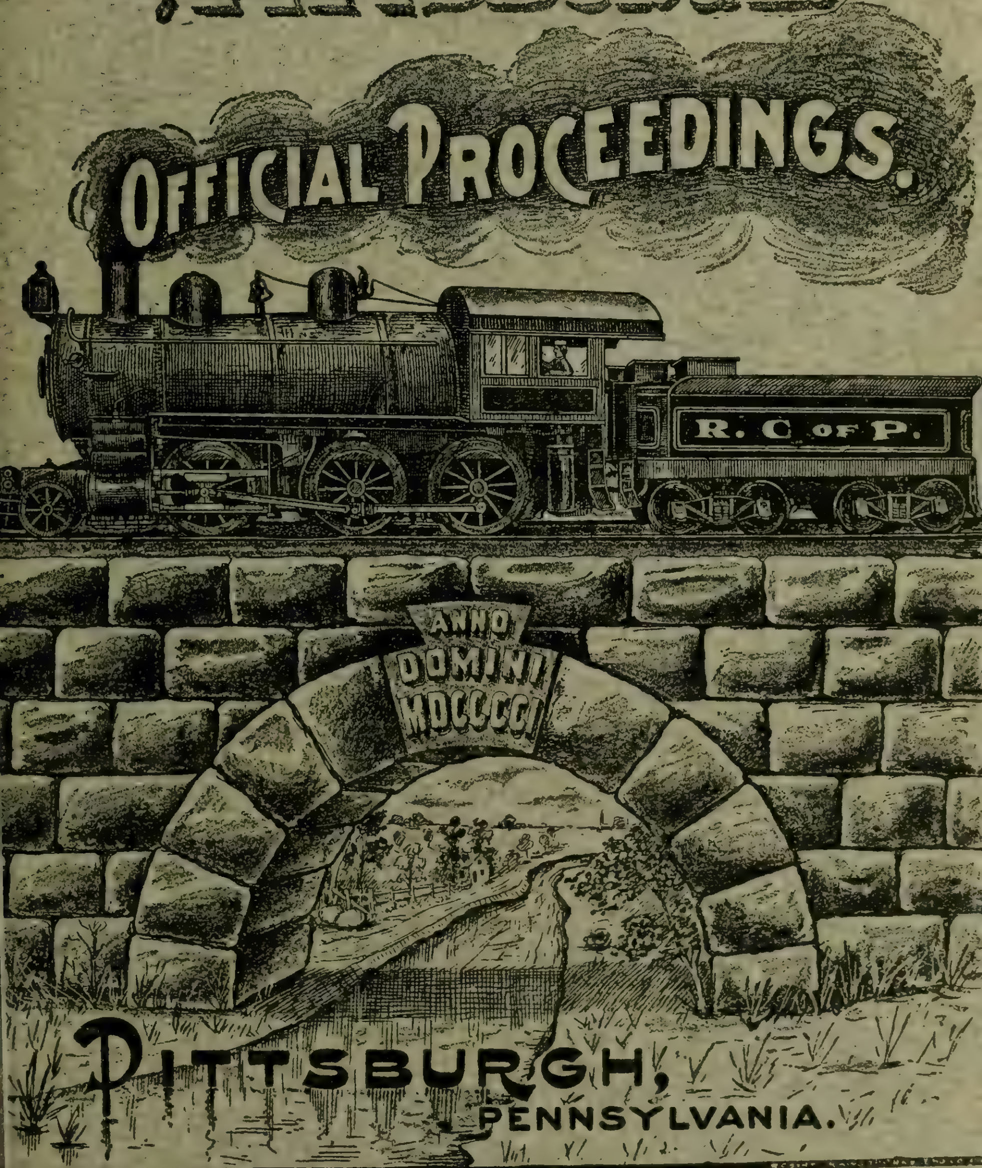

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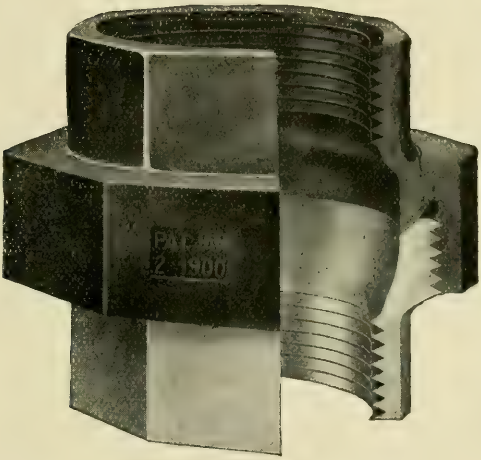

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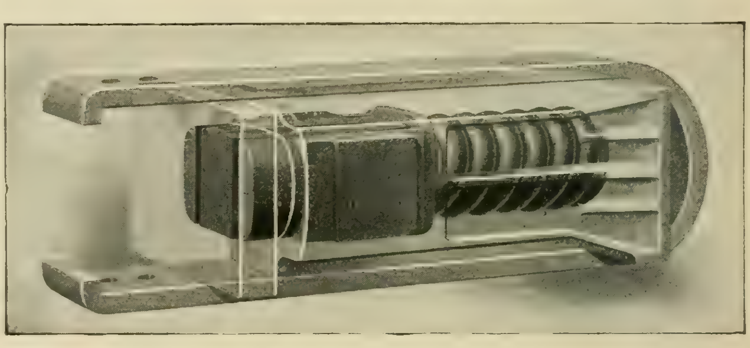

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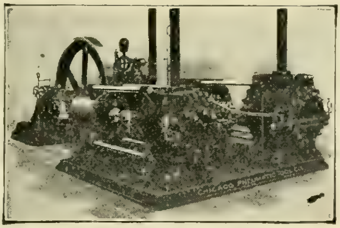

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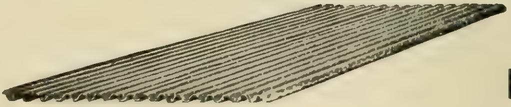

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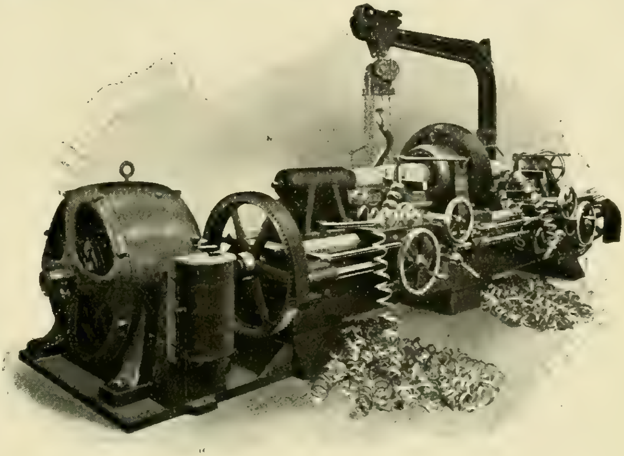

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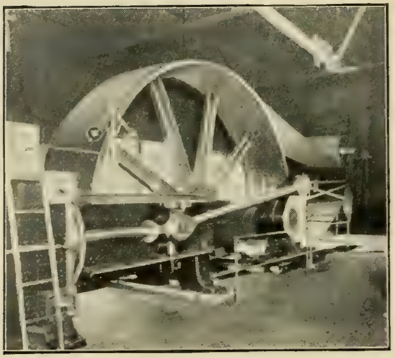

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VOL. VII.
No. 7.

Pittsburgh, Pa., May 22, 1908.

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Published monthly, except June, July and August, by the Railway Club of Pittsburgh,
J. D. Conway, Secretary, General Offices P. & L. E. R. R., Pittsburgh, Pa.

*Meetings held fourth Friday each month, except June, July and August.*

## PROCEEDINGS OF MEETING,

## MAY 22nd, 1908

The meeting was called to order at the Monongahela House, Pittsburgh, Pa., at 8 o'clock, P .M., with Vice-President D. J. Redding in the chair.

The following gentlemen registered:

## MEMBERS.

Alleman, C. W.
Allen, Harvey.
Anderson, H. T.
Anderson, J. B.
Ault, C. B.
Barnsley, Geo. T.
Bixler, H. C.
Blest, M. C.
Brand, Thos.
Brown, Geo. P.
Burkhard, A. A.
Campbell, Geo. E.
Chapin, E. S.
Charles, J. G.
Chittenden, A. D.
Colburn, Wm. W.
Comstock, E. D.
Conway, J. D.
Coulter, A. F.
Courtney, D. C.
Cunningham, J. D.
Curtis, H. C.
Dawson, W. J., Jr.
Deckman, E. J.
Drayer, U. S.
Duckham, A. E.
Dukesmith, F. H.
Fischer, Charles L.
Fleck, J. S.
Foller, C. S.
Gallaher, A. H.
Gano, J. H.
Gauss, E. E.
Gilg, H. F.
Giles, J. T.
Gray, C. B.
Grindlay, L. B.
Hackenburg, J. H.
Halleran, H. J.
Haring, Ellsworth.
Howe, D. M.
Hughes, J. E.
Irwin, O.
Isler, Chas. J.
Kennedy, Jas.
Keyser, R. H.
Kinter, D. H.
Kleine, R. L.
Knickerbocker, A. C.
Knight, E. A.
Koch, H. J.
Krause, Julius.
Kull, W. A.
Lindstrom, C. A.
Lobez, P. L.
Long, R. M.
Maguire, W. E.
Mawhinney, M. S.
Miller, F. L.
Miller, J. F.
McFeatters, F. R.
McIlwain, J. D.
McNulty, F. M.
Nagle, W. E.
Nagle, W. E., Jr.
Neison, W. J.
Nickerson, S. N.
Noble, D. C.
Painter, Joseph.
Patterson, C. C.
Peach, Wm. M.
Peacock, W. W.
Porter, H. V.
Pulliam, O. S.
Randall, E. J.
Redding, D. J.
Riddell, Wm. J.
Rinehart, H. W.
Sellers, C. E.
Schomberg, W. T.
Sitts, Lewis S.
Spangler, C. P.
Speck, H. J.
Stark, F. H.

Stuart, M. D.
Stucki, A.
Suckfield, G. A.
Swartz, H. E.
Taylor, H. G.
Townsend, T. E.
Tucker, John L.
Walker, J. W.
Warne, J. C.
Warnock, H. R.
Weisbrod, J. F.
Williams, W. J.
Wilson, W. J.
Wolf, Jos. C.

## VISITORS.

Allen, E. K.
Babcock, F. H.
Barth, John W.
Bateman, P.
Bennett, Thos. R.
Bower, J. G.
Cain, W. E.
Cook, Joseph A.
Cotton, Jesse L.
Cunningham, H. L.
Deakins, H. H.
Dildine, J. A.
Eastwick, Robt.
Ferree, E. C.
Ferree, H. W.
Fay, F. L.
Gale, G. W.
Gilmore, C. B.
Hood, A. N.
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Platt, J. G.
Ramsey, S. W.
Ralph, L. N.
Sargeant, W. A.
Schlay, O. C.
Schroeder, H. A.
Tennant, S. D.
Trist, N. B.
White, J. Howell.
Wiles, G. R.

The reading of the minutes of the last meeting was dispensed with, by common consent.

The Secretary read the following list of applications for membership:

Becht, Harry K., Supt. Transportation, Carnegie Steel Co., Donora, Pa. Proposed by A. W. Crouch.

Buffington, W. P., Chief Clerk to Supt. Transportation, Pittsburg Coal Co., Hussey Building, Pittsburgh, Pa. Proposed by Samuel R. Evans.

Forsyth, W. D., Genl. Manager, Trussed Concrete Steel Co., Youngstown, O. Proposed by A. W. Crouch.

Newsom, H. H., Rep., McCord & Co., Old Colony Building, Chicago, Ill. Proposed by J. D. Conway.

Smith, James, Supt. Lawrenceville Bronze Co., 31st St. and Penn Ave., Pittsburgh, Pa. Proposed by Edward Kerr.

Unger, J. S., Asst. Gen'l Supt., Carnegie Steel Co., Homestead Works, Munhall, Pa. Proposed by L. C. Bihler.

VICE-PRESIDENT: After these applications have been favorably passed upon by the Executive Committee, the gentlemen will become members.

The Secretary read the following communication:

To the Members:

At the last meeting of the Club a letter from Mr. W. E. Symons, Chairman of the M. C. B. Committee on Subjects was read, and the following resolution from the New York Railroad Club was referred to your Standing Committe on M. C. B. Rules of Interchange, for such action as is thought proper:

RESOLVED, That the New York Railroad Club in meeting assembled recommend to the Master Car Builders' Association that the Committee on subjects be respectfully requested to incorporate for investigation next year the desirability of standardizing certain sections of I beams, channels, Z bars, angles and tees, for use in designing and repairing steel cars and steel underframes, and that a list of such sections as may be considered desirable for this purpose should be submitted by this committee for adoption as recommended practice, in 1909.

RESOLVED, That this matter be taken up at once by the President and Secretary of the New York Railroad Club with the President and Secretary of the Master Car Builders' Association.

Your Committee concurs in the resolution adopted by the New York Railroad Club, and suggests that this action be approved by the members of the Railway Club of Pittsburgh, and that Mr. W. E. Symons be notified accordingly.

Respectfully submitted,

STANDING COMMITTE ON M. C. B.
RULES OF INTERCHANGE,
RAILWAY CLUB OF PITTSBURGH.

Altoona, Pa., May 22, 1908.

ON MOTION the report of the Committee is adopted and the Railway Club of Pittsburgh endorses the action of the New York Club.

VICE-PRESIDENT: I have to announce the death of two of our members, Mr. F. J. Shaler, who died March 16, 1908, and Mr. C. M. Frazer, Chief Clerk of the Freight Claim Department of the Union Railroad. I will appoint the following Committees to draft suitable resolutions:

Upon the death of Mr. C. M. Frazer, the following Committee was appointed: H. V. Porter, M. E. George and R. P. Keenoy; and as Committee upon the death of Mr. Fred J. Shaler, the following were appointed: Stephen C. Mason, Edward Kerr and John T. Brown, Sr.

The advance notice of the meeting, as you are aware, stated that an address would be delivered by John Marron, Esq., of Pittsburgh. Mr. Marron found at the last moment that it would be impossible for him to appear, and in this emergency we are highly favored in having Dr. Jesse L. Cotton, Professor of Hebrew in Princeton University, who will give us a short address on "The Man Worth While." I take pleasure in introducing to you Dr. Cotton.

DR. JESSE L. COTTON: Gentlemen—It is a pleasure to me to be here at this meeting. I tried my best to avoid coming. This morning when Mr. Stark called me up, he was so insistent I could not understand what was back of it. But knowing that Mr. Stark had in large measure the quality of the perseverance of the saints, I promised him I would come; but I have been regretting it ever since—because, looking into the faces of so many of you men, and having dined with some of you and finding out how well posted along some lines you are, I fear that I shall be unable to say anything that will be either interesting or instructive.

I understand it is customary at these meetings to have papers on technical subjects relating to your profession, which would naturally be expected; and as I have no technical knowledge of the work in which you are engaged, that will be entirely eliminated. However, I have tried to select a subject that is of interest to men everywhere, and I want to talk to you a little while on a question which lies at the bottom of all business and all enterprise and all undertakings of men. We find our callings in life, we choose our occupations, influenced in one way and another and by one motive and another. But down beneath all of these motives and influences there is the man himself, something that is higher and broader and deeper than any one calling or any one line of activity. I hope you all will agree with me that man everywhere is struggling, in his fight for a livelihood, not simply for the bare necessities of his physical existence. We may have very different standards of living, and what we regard as being a livelihood might include a great many of the luxuries of life. But there is something that reaches farther than simply seeking for a livelihood. It is right that we should engage in the various callings in life and seek to make a living, or seek for a livelihood. It is a splendid indication. How helpless and how useless a man would be, if there was not that in him that would lead him to try to do something in this world and to accomplish something in the material sense. To seek for a livelihood, to seek to surround ourselves with the comforts and pleasures of life, is conducive to happiness, is conducive to wider usefulness, is conducive to contentment, is conducive to building up a true and a noble manhood. But I am sure we will all agree that there is something far better, something far beyond the mere seeking for life's comforts and lifes pleasant enjoyments. In addition to and beyond the making of a living there is that which is of infinitely greater importance, the making of a life, and that is what every one of us has to do, no matter what our calling or our profession may be in the world among men. I believe that every one of us is made to feel from time to time that we are entrusted with greater business than simply to do the work that engages our attention from day to day. We are building character, we are developing manhood, we are making a life. That seems to be sometimes lost sight of in our struggle for a livelihood; and yet in our soberer moments we find that there are impulses and inclinations that reach far out beyond our profession, our particular line of human activity, that make us feel that after all we are akin with the great cosmic life, that make us feel that we are broader than that to which we are particularly devoting our attention.

Recognizing this truth, I have decided to talk to you a little while on "The Man Worth While." Seeing that underneath all our worldly activities and pursuits there is the man himself, who stands apart and alone, uniting him with humanity, and separating him from his mere profession or his mere calling, there comes the question, what is the life worth living, what is it that after all makes the man that is worth while? I suspect every one of you have become somewhat discontented with yourselves at times. You have felt like kicking your books under the desk and going out to the hills and letting things take care of themselves. You have been struggling and working and trying to do your best, and yet you have been disappointed at the little you have accomplished, and the more you have labored the more tangled things have become. It is a good thing for a man to feel that way sometimes—to feel something of his own incompetency and his own littleness, in order that he may lift his eyes and his heart and breathe the rarer air of a larger life, and that his thoughts may soar out beyond the things that immediately surround him, that he may catch glimpses, visions of truth and life far wider than what he is in daily contact with within his four square walls.

Well, it seems to me when we come to think of the man worth while we would say for one thing, whether the first or not, that in the man worth while there will be the element of industry. No man ever yet has been a man worth while unless he has been an industrious man. The man who will sit down and fold his arms in idleness and dream, the man who will simply live in luxury and idleness and ease, never can be a man worth while. It is the man who is industrious, the man who sees something that ought to be done, and then sets himself at it with the determination that he is going to do it, who is the man worth while. That is one element in true manhood, and one of the things that contribute to the making of the man worth while. This is splendidly illustrated in the calling in life in which you gentlemen are engaged. You are men of industry, you have your eye on the industries of the world as many men have not. You are kept in touch with the busy hum and rattle of machinery and the passing of trains and all those things, so that you are made to see and feel something of the power of industry. And in your individual life there must be industry if you are going to accomplish anything or do anything worth living for in this world.

But above and beyond this, again, there must be found in the man worth while a profound sense of honor and integrity. That is splendidly illustrated by men of your calling in many places and in many ways. We find everywhere that the man worth while is the man who is honest in his dealings, the man who can be trusted on all occasions and at all times, the man who has a profound sense of honor and appreciates the fitness of things in his dealings with his fellow-men. The one compliment which it seems to me is higher than almost anything else that might be said of a man is when it is said, "That man is the very soul of honor." When you come to know him in his business dealings and in his daily life, you find out that he has such strength of character, such nobility of purpose, such a lofty ideal that is controlling his life and holding him in check from the extravagances of life and from the temptations to which he is exposed, that you feel there is a man whom everyone must respect—a man to whom you would entrust more than you would to many another. This sense of honor is seen in consistency in speech and conduct, it is seen in integrity of character.

I have a good deal of respect for that man in Kansas who was engaged in the dairy business who in his earlier days had acquired the habit of profanity, and on occasions was extremely profane. But he had experienced a change in his life and saw the barrenness and weakness and wickedness of profanity, and he did what our children sometimes say they are going to do, he turned over a new leaf and was trying to do better, and he was doing better. He connected himself with the church and became very intimate with the pastor of the congregation. But he was engaged in the dairy business, and found that in the fly season it was very trying to his temper in dealing with the cows. And after thinking the whole situation over, and knowing how his old habit would come back on him now and then, he went to his pastor and said: "I am going to give up the church." "What!" said the pastor; "you have been such an active member and taken such a plain stand, you are not going to leave the church?" "Yes; I have been thinking the whole thing over, and there is one of three things I must do, and I feel that I must go out of the church. I have either got to quit the business I am engaged in, or I have got to quit the church or be a 'durned' hypocrite, and I have made up my mind to leave the church."

I say I have some sympathy with that man because he was consistent. He did not believe in making a profession and then not being true to it. So I say that one thing that contributes largely to the making of a man worth while is the sense of honor, that sense of integrity, that sense of consistency of life that makes one part of life of a piece with the whole, and we see the same characteristics manifested all through the days and years.

Then another thing that contributes to the making of a man worth while is the matter of truth. Nowhere is this seen more clearly, I think, than in the business life of the world. I know that men in the profession to which I belong look at that matter and speak of it very often; but we see it at a different angle from that at which you see it. You see the value of truth on its practical side; and the testimony of men of business the world over is that truth is one of the elements that must be found in the man that is to be worth while in any calling or in any pursuit or business. Truth is one of the elements that lie at the very foundation of all business, of all society, of all human organizations, and of all human intercourse. If you men did not recognize this, you could not stand together in an organization such as you have. It is because you trust your brother and speak the truth and expect the truth to be spoken to you, because you deal in truth and expect to be dealt with in truth and honesty that such an organization as this can be carried on and increase in usefulness and power. Truth is one of the foundation stones of life and of all business. In the business world we have the word "credit," in the religious world we have the word "creed." Both come from the same root, "credo," meaning, "I believe." The credit of a man or an institution is that which denotes the man or the institution as that which can be believed. The creed of the religious man is a statement of the truth he believes, or that is to be believed. This credit runs all through human life, and it must exist. There must be credit if there is to be any getting on in business at all. If you could not trust your fellow-man, if you did not believe in your banks and your associations and organizations of one kind and another, you could not carry on the business you are doing, you could not stand in that great army of men that are doing so much to bring the nations of the earth together and weld humanity into one, and so giving a tremendous living illustration of the truth of Holy Writ when it says, "God hath made of one blood all nations of men to dwell on all the face of the earth." In your business and your enterprises you are making that truth to stand out with fearful boldness in such striking characters that a wayfaring man, even though he were a fool, may see and believe it.

Then another element that contributes to the making of a man worth while is fidelity. This closely borders, of course, on the matter of truth. Not only the speaking of truth, but the living of truth and being true in our various relations in life. About a year ago a banker of this city came to me and asked me if I knew of a young man possessing certain characteristics, and a high education was not one of them, but certain characteristics that would fit him for a position in the institution with which he was connected in a prominent way. He said: "I can get plenty of young men, but it is a young man that can be trusted, a young man that will be faithful, that I want, and they are woefully scarce and hard to get." I suppose many of you could testify to that very same thing. You can get men, but you find how difficult it is to get the man that is worth while for the position of trust and of honor you wish him to occupy. There isn't anything that contributes more, it seems to me, to the making of a man worth while for all life's relations, than this very matter of fidelity, being able to put a man, who will assume certain responsibilities, in a position and feel that that man can be trusted—that you can leave him out of your sight and know things will go just as well when you are not present as when you are present. I tell you that is one of the things that tremendously tests a man's character and tests human life. It is an element in life that is simply sublime. A man who has that sense of fidelity, who will be true and faithful through good report and evil, under insinuations that may be hurtful and in the face of complimentary remarks that may be encouraging and helpful, is a man worth while. For one to persist in his level tenor of honesty and integrity and fidelity to his trust, which may often seem drudgery, with a dogged persistence, that is a trait of character admired and honored by all right thinking men. Fidelity, carefulness to one's trust, whatever his position may be, is one of the things that contributes largely to the making of the man worth while; and the man who is not faithful is not a man worth while in any place.

Then another element that figures very largely in the man worth while is that the man shall be courteous and thoughtful of others. You all know the truth of that in many ways. I have in mind just now an instance of a merchant into whose store I have almost vowed I would never go again. Although I think the man is strictly honest and upright in his business; yet he is so utterly lacking in courtesy that I do not feel comfortable in dealing with him. I remember the last time I was in his store he seemed to think it was a great privilege to me for him to be willing to wait on me at any time and take the trouble to show me even the single article I might wish to purchase. I may be wrong in that feeling, but it illustrates what I wish to emphasize: that the man worth while must be a man who is courteous, that he will discommode himself for the time that he may show regard for those around him. You men who employ others like to hear it said of the man in your employ, "That man is a gentleman." You like to have persons who meet with him in one way or another speak of him in this fashion, that he is a man of gentle spirit and kindly disposition, ready to listen to and help those with whom he deals. This matter of courtesy is one of the essential elements in the making of a true man—kindly, thoughtful regard for the interests, comfort and welfare of those around us.

Another element still that contributes to the making of the man worth while is the element of courage. This is a factor in human life that is sublime. It is a grand thing, a splendid thing, to see a man who, when danger confronts him, when probable loss stares him in the face, will yet have certain convictions of right and wrong and of duty, and have the courage to stand by them. There are plenty of men who know what right is. Most men have a pretty accurate sense of what is right. But it is not every man who has the courage to stand by what he believes to be right, who will speak when it is necessary to speak, on the side of truth; who will act, when it is necessary to act, on the side of what he knows is right, when the whole drift of things is tending in the opposite direction.

This was brought very vividly to my attention this last winter in reading some of the Colonial history of our country. The question was up in the Colonies regarding the oppression of our people in this country by the home government in England. England was oppressive in many ways, and many noble spirits in the Colonies were advocating a blow for liberty in declaring themselves free and independent of the mother country. There were others again who were trying to dissuade these advocates from that position. There were others, too, who were thoroughly indifferent and had no interest in the matter practically one way or the other. But different Colonies had their meetings, the Continental Congress convened, and a number of men from the various Colonies were sent up to attend this Congress, when the matter was to be decided as to the attitude the Colonies should maintain toward the home government. From Princeton College went up John Witherspoon, the first president of the college after it came to Princeton, and one of the signers of the Declaration of Independence. When they saw that the matter had to be decided, there were some who talked stoutly against it, and others who were not willing to say a word one way or the other. The situation was ominous. At this juncture John Witherspoon arose to his feet in the presence of the assembly and said: "Gentlemen, there is a tide in the affairs of men, a nick of time. We perceive it now before us. To hesitate is to consent to our own slavery. For my own part, of property I have some, of reputation more. That reputation is staked, that property is pledged on the issue of this contest; and although these gray hairs must soon descend to the sepulcher, I would infinitely rather that they descend thither by the hand of the executioner, than desert at this crisis the sacred cause of my country." That was the note that awoke the spirit of courage in the heart of almost every man present. The Declaration of Independence was drawn and signed, and John Witherspoon's name stands near the top of the list of the signers. I never realized before as I did in reading this history, how daring a thing that was for that man to do, and for other men to do. What a courageous thing it was. But he was convinced of duty, he was convinced of the thing that was right, and he had the courage of his conviction. He did not know but that his property would all be taken away, he did not know but that his reputation would be blasted, he did not know but that his name might go down through all the years to come as that of a traitor to his country. But he was persuaded that injustice and oppression were wrong, and that it was the right and proper thing for a man to do—to stand in the defense of his manhood and in respect to that which made and consituted him what he was. And so there are dangers that arise today, there are probable losses that confront us, and we have got to take the right attitude. We must be men of courage.

Sometimes we hear men say it is difficult to be a business man along certain lines and be a Christian, be a true man, true to the instincts of our own nature. That is a certain indication that there is a call for courage on your part and on my part, that we must be ready to face probable loss, that we must be ready to confront possible danger in the interest of that which is right and true. We all today, no matter what our political affiliations may be point with pride to our Chief Executive. Whatever mistakes we may feel that he has made—for he is human—we all feel that President Roosevelt is a man true as steel, that he is a man of convictions, and that when he sees a thing to be right and true, no matter how great may be the forces that oppose themselves, he speaks out in defense of what he believes to be right and what he believes to be true. I think we will all give him credit for being a man of courage and a man who wants to do that which is right, however he may have made mistakes in this or that. So we say that one of the elements contributing to the making of the man worth while is this element of courage; and there is no life where that is not called for.

Still another feature in the man that is worth while is the element of self-control. After all, about the hardest thing we have to do in this world is to control ourselves. It is a good deal easier to boss other people than it is to boss ourselves; it is a good deal easier to make a person who is under you do what you want him to do than it is to make yourself do what you know you ought to do. We have high authority for the statement that he who ruleth his spirit is better than he that taketh a city. The man of self-control is a man worth while. This element of human character was recognized in the pagan world. One of the seven virtues of the Greeks, who developed manhood in many ways to a high degree of excellency, was the virtue of self-control. The Spartan mother was diligent in teaching her children that they must learn that virtue among the very first lessons in life, that they could never accomplish much in the world if they were lacking in that virtue. We need that virtue today. Sometimes we seem to forget the value of such a virtue; we seem to think that by giving license to all the impulses and feelings of the inner nature we are attaining our largest liberty, when thereby we may be bringing ourselves into the deepest slavery. We have members that must be controlled. Some of us by nature have fiery dispositions, and it does not take very much to set us off, and we let our tongues run to our own hurt and to the injury of those around us. It is a great thing for a man who is naturally impatient to hold his tongue in check, to keep his temper under, to so control himself that he will not speak rashly when provocation comes. The man who allows his temper to get the better of him is always the weaker man. Take two men in debate and let one of them become angry and he is sure to be weakened by it and lose his cause; while it is the man who can control himself, no matter what personal reflections, no matter what taunts or flings may be thrown at him, who still does not lose his poise but can hold himself in check and follow his course through, who is bound to win in controversy. So it is all through life. We must have that virtue manifested by the farmer who went out to the barn to milk his cow. He had just finished milking when the cow lifted her foot and kicked over the bucket, spilling all the milk. He was very angry. "Yes, sir," he told his wife, "I was just that mad I could have killed the old brute. I was just so mad that I—I just sat down and milked her right over again." While we may feel mad enough at a person sometimes to nearly kill him, we must be ready to sit right down and do the work over again that may have been spoiled by the kicking of somebody around us connected with what we were doing.

Then not only must the temper beheld in check, but this spirit of self-control must manifest itself in the whole nature. There are habits to be kept in check, and how often we allow them to run unguarded.

I want to speak a word of commendation for what the railroads are doing in the cause of temperance by requiring all men in their employ to be men of sober habits. In doing this you men are doing something that is wielding a tremendous influence over the young life of our country, over young men who are looking up to your calling in life and think it is a great calling. They learn that this is what you require of your employees, men who will never deaden their senses by intoxicating liquors. Our habits must be kept in check, and by controlling ourselves we are making of ourselves men worth while, men that will accomplish something worth the doing in this world.

And I have just one more thing to say and then I will quit. Another element, and the crowning element in my judgment, and I think in the judgment of you men, that contributes to the making of a man worth while is that he shall be a Christian man. As we look through the book of history and turn over its pages here and there, we all stand in adoration and admiration, and most of us perhaps in worship, before the Man of Nazareth as being the supreme, collosal example of the manhood, or of the man worth while. I tell you, my fellow-men, the man who takes Christ into his life, the man who receives the truth from heaven, whose ear is attuned to hear the voices that are above this world, is the man who is going to allow influences to come into his life that will strengthen and ennoble as nothing else possibly can. The Greek word for man is a word which means "the up-looking one." I do not know how many Darwinians are here, but if you are a Darwinian I know you will assent to this. By the very fact that a man's fore limbs are taken up from the earth and are not used for the purpose of locomotion, his face is lifted toward the heavens; his face is lifted above the sod that he may have a broader, wider horizon, that he may see things that are above and beyond himself. His eyes are not downcast to the earth all the time. The face uplifted, the vision outstretched and reaching out beyond to receive influences and inspiration from forces and energies that are higher than the things that are merely earthly, is an indication of what man is intended to be. The man who has the spirit of the Christian in his life is the man who has that which will make him worth while.

Now, Christianity is often counterfeited, and very often men judge of the real thing by the counterfeit. However, we do not do that with money. If you happen to come across a counterfeit dollar, you do not say that all money is counterfeit and useless. The very fact that the dollar is counterfeited shows that it is worth counterfeiting. And the very fact that the Christian life is counterfeited shows that it is worth pretending. But that is only evidence that it is worth counterfeiting; it is only testimony to the value of it. I think every man of us ought to indentify himself with the church of Jesus Christ in the world. It is God's institution; it is the one institution that has been given to men for their perfecting in character, including men of all callings and of every walk in life, of every degree of culture and intelligence, of every station or position in this world. A man ought to be actively engaged in the work of the Great Master, for we are to live for things that are beyond and for the things of eternity, as well as for the things that are present and the things that are of time. It is a mistake, of course, for us to be in the church simply for its emoluments, for the position it offers, for the opportunities it affords, or for the fellowship to be there enjoyed. Many men, I fear, are in the church simply for that reason, because it is the thing to do, because it is the popular thing in certain communities to be a member of the Church. This is the greatest mistake in the world. No man ought to be in the church unless he is first of all a member of Jesus Christ, and has taken Him as his guide and is looking upon Him as his inspiration and support. Only such a one should be a member of the church of Jesus Christ.

This reminds me of a story of an Irishman who came to this country. He had been in New York a short time and one day he wanted to go across Broadway, but there was a funeral procession passing, and it was a very long procession. He waited until he became weary, and still there was no end to the procession in sight. He stepped up to the policeman on the corner and asked him who this man was that had such a fine funeral. The policeman said he didn't know, but that he must be a great citizen to have a funeral like that. He waited a while longer and still the funeral kept on, and he stepped up to a street cleaner and asked him who the man was that was having such a fine funeral. He says, "The man that can have such a fine funeral as that must be a great man in the country." The street cleaner said he did not know whose it was, but he agreed that he must have been a very great man. After a time the procession came to a halt for some reason, and the Irishman stepped up to the door of a cab and poked his head in at the window and asked the solitary occupant what the name of the man was who had such a wonderfully fine funeral. The man says, "You have me now; I don't know. I am simply in it for the ride."

I fear there are a great many men who are in the church simply for the ride.

With these elements which I have named, I hope that I may have brought before you something that contributes to the making of the man worth while to occupy any position or to engage in any work in life.

I thank you for your very kind attention.

VICE-PRESIDENT: I am sure we all agree that we have been splendidly entertained by Dr. Cotton's discourse. There are no technical papers to come up this evening, and perhaps we can hear from some of the members. Brother Gilg is generally able to say something apropos.

MR. HENRY F. GILG: I promised Dr. Cotton when I was introduced to him this evening that if he made any nice remarks I would join in the applause which he would be sure to get at the end, and I can join in that with the heartiest spirit. I am free to say there has been no speaker here in my experience who has been tendered the ovation he has had. The members of the Club all feel, I am sure, as I do, that it is a good thing to get away from the technical questions once in a while and have the truth told to us about what we ought to do. Dr. Cotton has given us some thoughts to ponder over, to apply to ourselves and to follow out in our daily lives.

From my side of the fence, not being a railroad man but catering to railroad men, I have found in many years of selling to them that adhering strictly to the truth, carrying out all the statements that I make, has made me successful. And when a man so eminent as Dr. Cotton tells us of these things I know that I am on the right track.

Now I feel that the best thanks of the Club are due to Dr. Cotton for helping us out tonight and taking the place of Mr. Marron, and I offer a motion that we give him the hearty thanks of the Club and ask him to stop here at his convenience and make himself at home with us.

The motion was duly seconded and carried unanimously.

MR. GEO. T. BARNSLEY: The gentleman who made the motion perhaps did not think of it at the moment, but I should like to have that include thanks to our Ex-President, Mr. Stark, for getting so eminent a man to talk to us. To Mr.

Stark is due a great deal of credit for his ability to get Dr. Cotton to address us.

MR. GILG: I accept the amendment with pleasure, but I could hardly be expected to make any apology to Mr. Stark for overlooking him, because we simply expect him to do things of that kind.

VICE-PRESIDENT: Mr. Stark, I can assure you that you are included in the vote of thanks.

A VOICE: Dr. Cotton, when he got up to speak, said he did not know very much about our technical matters. Before he got through I came to the conclusion that he knew a good deal about the rules of interchange and about recommended practice and standards.

VICE-PRESIDENT: He certainly did. I explained to the Doctor this evening that one of the principal duties and pleasures of this organization was to maintain a Committee, known as the Inter-change Committee, to present suggestions or amendments to the Master Car Builders' Association each year to better the Rules by which alone it is possible to move cars from one railroad to another, and without which Rules and the feeling of honor and belief in the truth of our fellow-men that exists among the railroads to-day, largely as the result of the M. C. B. Rules, the business of the country would be tied up from time to time at interchange points. It could not move. We think that is one of the great things we do in this organization, to assist to move the cars of the country.

Is Mr. J. J. Neison in the room? We would like to hear a few remarks from him.

MR. J. J. NEISON: This is the first time I have had an opportunity to say a word to the Club. I thank the President for giving me this opportunity, especially on an occasion when you have listened to such a brilliant address from a fellow-townsman of mine. Brother Stark knew when he called upon Dr. Cotton to come here that he had a fine substitute for Mr. Marron. And I am very glad that he had been placed upon the right side, in the right direction. That is, our destination from this time will be upwards. Mr. President, I thank you for calling upon me, and I hope you will excuse me if I do not say anything more.

VICE-PRESIDENT: Mr. Stark has been referred to quite frequently, and it is only fair that he get up and say something in his own defense.

MR. F. H. STARK: I feel that we have been favored to-night with a very able address, and I am sure we all concur in what the Doctor has said. Some of us may be a little like the fellow about whom some one asked what denomination he belonged to and they said he belonged to such and such a church but he was not working at it very much. Possibly that might apply to some of us. However, our effort in trying to secure Mr. Marron, and also Dr. Cotton, was that something might be said in the way of encouragement to young men. As we grow older we realize the importance of encouragement to young men to get them started on the right track. Dr. Cotton referred to the fact that inquiry was made for a young man to take a position in a bank. I can verify that myself. I know of a certain banking institution that was looking for a young man, and in considering the young men in our borough of about 5,000 there were only about three or four boys just out of high school that the directors thought would be satisfactory, and I am glad to say one of the young men is in this room to-night. It is true, when people want young men to fill important positions they look around and pick out the young man of character. That is growing more and more every year with all interests, including the railroad world. As the Doctor said, many times young persons get discouraged and fear there is no use in trying, that the fellow who is rough, who gets along by deception, is the most successful. But that is not true. We should study the matter carefully and figure out for ourselves whether it is worth while. We had a living example in our late President, who was a man of integrity, and those of us who attended his funeral heard the words of one who knew him well, who gave Mr. Watts one of the greatest compliments that a man could receive. It might be said that a man of Mr. Watts' character would not be able to run a division on a railroad, but nevertheless Mr. Watts was known for his exemplary life, and I believe we will all agree that he is just as well off, yea, better, for having lived the life he had. I believe, too, that young men are too ambitious and want to travel too fast. I heard the State School Commissioner of New York State deliver an address before the graduating class at Albany, New York, and he followed a different line. Most lecturers tell a young man to place a mark and then struggle to attain it, and they will recite a list of many of our Presidents and great men. This Commissioner said that he found there were a great many men just like himself that were surprised to think they were holding the positions they were filling, and he quoted a large number of judges and other prominent men who said there was no one more surprised at being able to fill their positions than they themselves. And that is a pretty good attitude for a young man to take. If we are so self-confident and have such an exalted idea of ourselves that we feel we are kept down and have not the positions we ought to have, that we have not been recognized, that is dangerous ground. But it is the young man that fills the position to the best of his ability and is in a measure satisfied with his position; no matter what task is given him to do he does it faithfully. I will take my chances on that man being selected to fill a more important position than the young fellow that feels that he has not been appreciated and is all the time grumbling.

The Pittsburgh Railway Club, as well as similar organizations, is a school. A young man should come here and take part. I remember when I first attended the Master Car Builders' conventions when I was quite young. Two or three of the elderly gentlemen came around and said some encouraging words. Some of us were only able to get up and second a motion or say a few words and sit down. I remember when Mr. Marden came to me and said: "Thats right, young man, get up on your feet and don't wait; get up before somebody takes all your ammunition away." It is through the practice of talking before gatherings that we are able to talk in public at all. I wish our young men would take advantage of the opportunity and not let us older fellows do all the talking.

I am very much gratified that we have Dr. Cotton with us to-night. I know him personally, and I respect him as a man in his calling having the courage to teach the truth fearlessly, and I am more than delighted that he has been with us and I am sure we all appreciate it.

VICE-PRESIDENT: If there is no further business to come before the meeting, a motion to adjourn will be in order.

ON MOTION—Adjourned.

# In Memoriam

## FREDERICK J. SHALER

Whereas, God in His all-wise providence has removed from our midst one our members, Mr. Frederick J. Shaler, who died on March 16th, 1908, we, the committee appointed to present suitable resolutions, suggest that the following be spread upon the records of the Club:

Mr. Frederick J. Shaler was one of the charter members of the Club, always taking an active interest in its welfare and in regular attendance at its meetings. He was a man liked by all who had an acquaintance with him, and the Club has, through his demise, lost one of its most useful members, and in our expression of sorrow we also extend our earnest sympathy to the family of the deceased.

STEPHEN C. MASON,
EDWARD KERR,
JOHN T. BROWN,
Committee.

# In Memoriam

## C. M. FRASER

In the death of one of our members—Mr. C. M. Fraser—we are conscious of a genuine loss. One had but to meet him to know Mr. Fraser, and to know him was to be benefited, for his was a fine consistent Christian character, and his death will be deeply regretted by his friends and business associates. As fellow-members of the Railway Club, and as his associates in the railroad business, we are sympathetically united with his family in their bereavement, though bowing to the will of God.

Resolved, That this expression of sympathy be spread on the minutes of this Club and a copy of same be presented to the family.

H. V. PORTER,
M. E. GEORGE,
R. P. KEENOY,
Committee.

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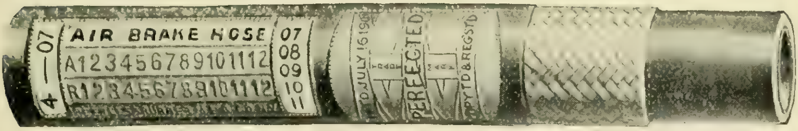

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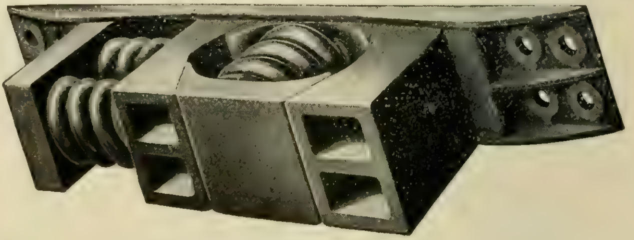

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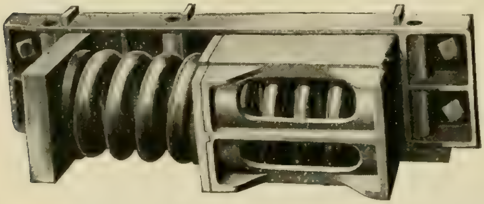

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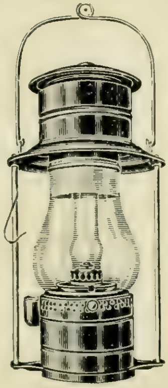

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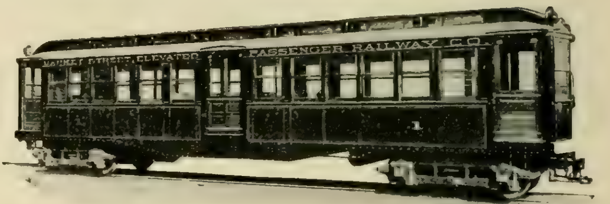

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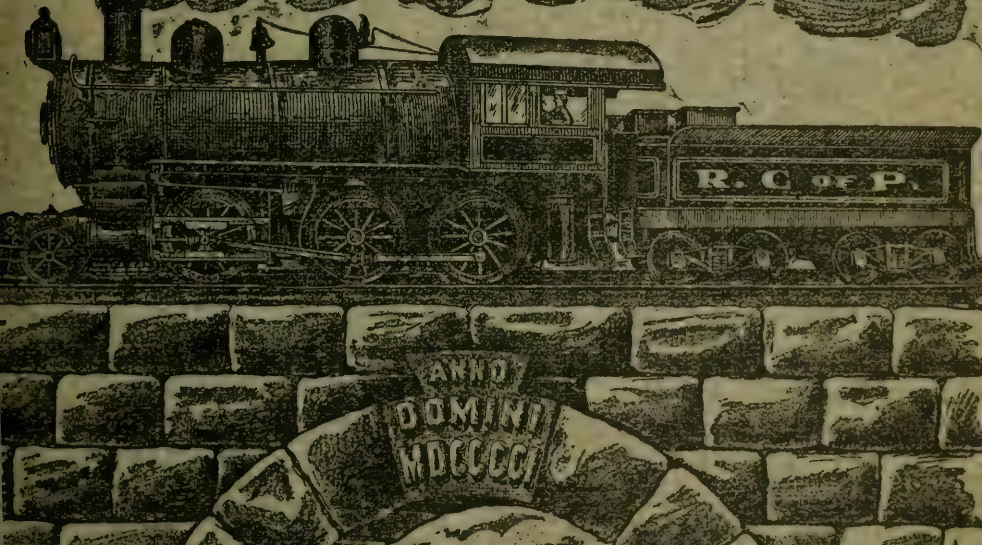

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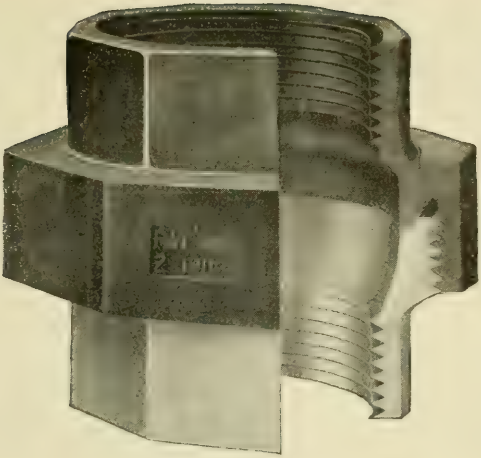

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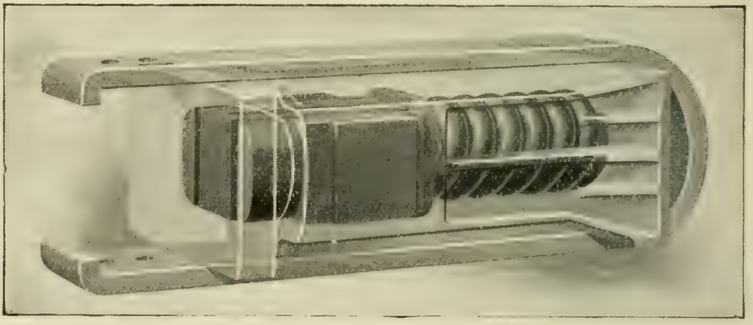

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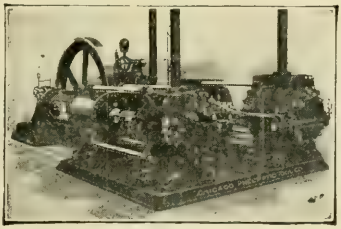

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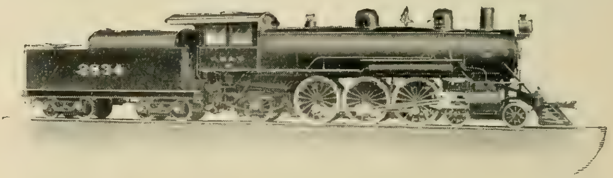

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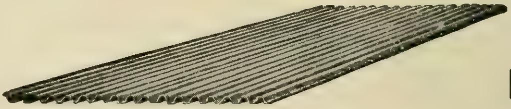

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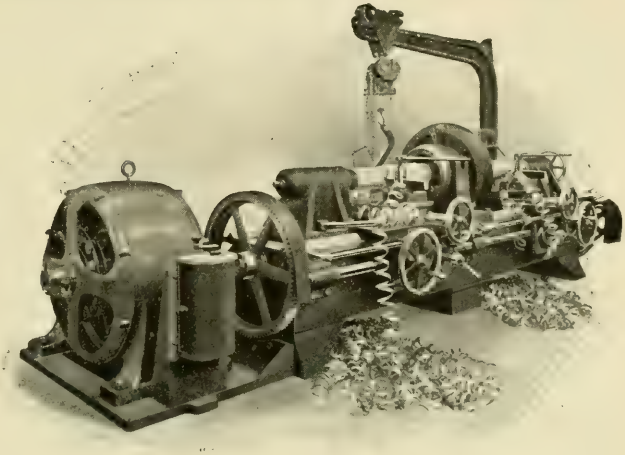

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# J. D. McILWAIN & COMPANY

## 208 THIRD AVENUE, PITTSBURGH, PA.

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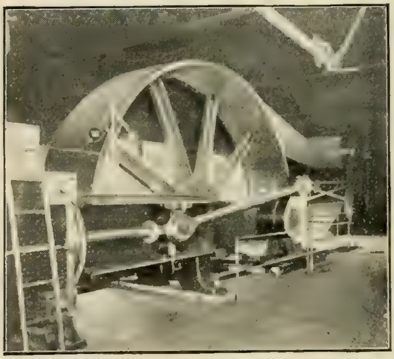

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MILL, MINE AND CONTRACTORS' **SUPPLIES**

# J. D. McILWAIN & COMPANY

# OFFICIAL PROCEEDINGS

*of the*

# Railway Club *of* Pittsburgh.

ORGANIZED OCTOBER 18, 1901.

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Vacant.

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*Meetings held fourth Friday each month, except June, July and August.*

## PROCEEDINGS OF MEETING,
## SEPTEMBER 25th, 1908

The meeting was called to order at the Monongahela House, Pittsburgh, Pa., at 8 o'clock, P .M., with Vice-President D. J. Redding in the chair.

The following gentlement registered:

## MEMBERS.

Alleman, C. W.
Barnsley, Geo. T.
Bealor, B. G.
Bigham, C. G.
Bixler, H. C.
Brand, Thos.
Brown, Geo. P.
Burry, Vincent J.
Cline, W. A.
Cole, Jewett.
Conway, J. D.
Courtney, D. C.
Coulter, A. F.
Craig, E. A.
Cunningham, J. D.
Dawson, W. J., Jr.
Donovan, H. A.
Dorr, C. O.
Gallinger, Geo. A.
Gardner, H.
Grewe, H. F.
Gies, Geo. E.
Gilg, Henry F.
Gorsuch, J. W.
Grove, E. M.
Halliwell, C. J.
Harris, J. D.
Henderson, J. W.
Hoops, R. E.
Howe, D. M.
Huyett, E. G.
Hyndman, F. T.
Kessler, D. D.
Kinter, D. H.
Knickerbocker, A. C.
Knight, E. A.
Kull, W. A.
Lee, L. A.
Lobez, P. L.
Long, R. M.
Lowry, R. N.
Lynn, Samuel.
Maguire, W. E.
Mercur, H. T.
Milliken, I. H.
McNulty, F. M.
Neely, J. L.
Noble, D. C.
Northwood, W. G.
Oates, Geo. M.
Orchard, Charles.
Peacock, W. W.
Porter, H. V.
Randall, E. J.
Redding, D. J.
Reeve, F. J.
Riddell, W. J.
Ryan, W. F.
Sattley, E. C.
Smith, D. W.
Smith, H. H.
Stafford, Saml. G.
Stark, F. H.
Stucki, A.
Stuart, M. D.
Suckfield, G. A.
Sweeley, G. P.
Tate, R. H.
Trinler, Chas. M.
Turner, L. H.
Unger, J. S.
Warnock, H. R.
Weisbrod, J. F.
Zinsmaster, F.

## VISITORS.

Blatz, Frank A.
Bolinger, J. C.
Bolinger, W.
Bosley, N. D.
Brooks, Jas. B.
Buenting, O. W.

Clements, Frank.
Cooke, J. L., Jr.
Cooper, F. E.
Cross, C. W.
Cruger, J.
Davies, H. K.
Dwyer, John.
Fisher, J. H.
Forrester, W. A.
Foster, W. E.
Glasgow, M. S.
Goron, F.
Gulentz, Chas.
Hanlon, N. D.
Hilberry, H. H.
Hinkens, Geo. F.
Jackson, C. A.
Key, James E.
Lee, Frank H.
Louch, W. G.
Macoubray, R. J.
Miller, A. T.
Miller, B. W.
Miller, Earl.
Morse, R. C., Jr.
McCurdy, Oscar.
McDermott, C. R.
Noah, W. J.
Parker, Wm. G.
Platt, M. C.
Radcliffe, J. R.
Richardson, F. M. M.
Ridgeway, H. T.
Ronstrom, W. L.
Rumbarger, F. A.
Schultz, M.
Seibert, Wm. L., Jr.
Shaffer, T. H.
Sleeth, S. D.
Sonnet, Adolph.
Thatcher, Ralph H.
Whitmore, S. E. G.
Woodworth, R. B.

The reading of the minutes of the last meeting was dispensed with, the Proceedings having been printed.

The Secretary read the following proposals for membership:

Bailey, Robert J., Car Accountant, Monongahela River Consolidated Coal & Coke Co., No. 8 Market St., Pittsburgh, Pa. Proposed by J. D. Conway.

Dougal, R. M., Rep., Penna. Lubricating Co., Pittsburgh, Pa. Proposed by H. V. Porter.

Klein, Robert A., Asst. Supervisor, P. R. R., 328 North Negley Avenue, Pittsburgh, Pa. Proposed by Harry W. Lehr.

Maxson, H. W., Sales Dept., Carnegie Steel Co., Pittsburgh, Pa. Proposed by H. V. Porter.

Mayer, Adolph, Jr., Sales Dept., Carnegie Steel Co., Pittsburgh, Pa. Proposed by H. V. Porter.

Montgomery, R. B., Mgr., H. W. Johns-Manville Co., Pittsburgh, Pa. Proposed by H. V. Porter.

McAlarney, J. H., Sales Dept., Carnegie Steel Co., Pittsburgh, Pa. Proposed by H. V. Porter.

McAndrew, R., Storekeeper, B. & L. E. R. R., Greenville, Pa. Proposed by H. V. Porter.

McInnes, Alexander, Jr., Sec'y. and Treas., McInnes Steel Co., Ltd., No. 437 East Main St., Corry, Pa. Proposed by A. W. Crouch.

Rea, C. S., Vice Pres., Damascus Tool Steel Co., Pittsburgh, Pa. Proposed by J. D. Conway.

Smith, W. A., Mgr., Lino Paint Co., Collinwood, Ohio. Proposed by J. D. Conway.

Snyder, F. I., care B. & L. E. R. R. Co., Carnegie Building, Pittsburgh, Pa. Proposed by H. V. Porter.

Wetmore, S. M., Gen'l. Mgr., Carbon Steel Co., Pittsburgh, Pa. Proposed by J. D. Conway.

Whipple, A. L., Sales Mgr., Forsyth Bros. Co., Fulton Building, New York. Proposed by F. T. Hyndman.

Woodworth, R. B., Sales Dept., Carnegie Steel Co., Carnegie Building, Pittsburgh, Pa. Proposed by H. V. Porter.

Woolley, W. S., Woolley Gas Power & Equipment Co., No. 1214 Sherman Ave., North Side, Pittsburgh, Pa. Proposed by F. M. McNulty.

Wright, C. W., Sec'y., Steel Car Forge Co., Pittsburgh, Pa. Proposed by H. V. Porter.

Wright, J. L., Freight Agent, P. C. C. & St. L. Ry., Carnegie, Pa. Proposed by F. M. McNulty.

SECRETARY: It was decided by the officers at a recent meeting to hold a smoker at the time of the annual meeting, which comes next month.

PRESIDENT: Next in order is the nomination of officers for the ensuing year.

SECRETARY: Before going into the matter of nominations, I hope it will not be considered out of place for me to suggest that my name shall not be considered for the position of your Secretary for another year. I could not undertake the work, considering the other duties I now have to perform. I certainly appreciate the hearty support which you have given me as your Secretary for the past seven years, but I am obliged to decline a renomination at this time.

ON MOTION of Mr. F. H. Stark, the chair was instructed to appoint a committee of three on nominations, to make a report later in the evening.

The President appointed as this Committee Messrs. F. T. Hyndman, F. J. Reeve and H. R. Warnock.

PRESIDENT: I would ask this Committee to get together and be prepared to report before adjournment.

If there is no further business, we will listen to the reading of the paper of the evening, and I take pleasure in introducing Mr. C. W. Cross, Superintendent of Apprentices of the New York Central Lines, of New York, who will present the paper on

# PRACTICAL RESULTS FROM A MODERN APPRENTICESHIP SYSTEM.

BY MR. C. W. CROSS, SUPERINTENDENT OF APPRENTICE SCHOOLS, NEW YORK CENTRAL LINES.

The apprenticeship question has attracted wide attention during the past few years, and so much has been published concerning general theories and the details of different systems which have been installed by various industrial concerns, that it is proposed in this paper to avoid a description of detail methods and to emphasize the importance of the practical results which have thus far been obtained from improved apprenticeship systems on railroads, the first of which was established on the New York Central Lines about two and a half years ago.

The fundamental purpose of an apprentice system is to recruit the ranks of skilled workmen and to improve the individual efficiency of the mechanics. As industrial concerns have grown larger and larger and conditions have changed, the apprentice has almost been lost sight of, and the mechanical officers of the railroads and the officers of manufacturing establishments awoke a few years ago to find that the apprenticeship systems, as they then existed, were practically useless and that something must be done at once to remedy the difficulty. That it was a grave one will be indicated by reading the proceedings of the national engineering societies and the technical press during the past few years.

For years the apprentice question had periodically come before the American Railway Master Mechanics' Association, but the suggestions which were made and such action as was taken, were along the line of patching up and improving the old system. In 1905, however, Mr. G. M. Basford made a forceful address before that association, which was enthusiastically received, in which he directed attention to the great need of a new system, pointed out the defects in the old methods and outlined the basic principles of an apprentice system which would give successful results under modern conditions.

The apprenticeship system of the New York Central Lines is based largely on the general principles laid down by Mr. Basford; the practical details have been carefully worked out by the apprentice department. This system, istalled under the general direction of Mr. J. F. Deems, G. S. M. P., was described at the 1906 meeting of the Master Mechanics' Association and a very complete detailed description of it was published in the American Engineer and Railroad Journal during June, July, September, October and November, 1907. In brief, it consists of a superintendent of apprentices and his assistant, who have charge of the work and lay out the educational courses. At each large shop on the system is a drawing instructor, who has charge of the educational work, each apprentice spending four hours a week in the class room, where mathematics, mechanical drawing, etc., are taught. The apprentices in the shop are in charge of a shop instructor, who sees that they receive the proper instruction in the trade, do their work well and that they are shifted from one class of work to another at regular intervals.

The most important and far-reaching results of such a system will, of course, not be apparent until several years after it has been placed in operation. The railroads and industrial concerns which have established modern apprenticeship methods look for future and not for immediate returns. However, the practical results which have already become apparent on the New York Central Lines, in spite of the comparatively short time in which it has been in operation, are remarkable.

The most noticeable result from the installation of the new apprentice system has been the increased efficiency of the apprentices. This is largely due to the addition of the shop instructor, although the benefit of the class room work is also apparent. Under the old system the foreman was expected to see that the boys received proper instructions concerning their work and that they performed it properly. Ordinarily the foreman is too busy to give the boy anything like the proper amount of attention. With the addition of the shop instructor, who has the duty of looking after the boys, the efficiency of the apprentice has very greatly increased, with a resulting improvement both in the amount of output and the quality of the work done. There is no question but that the work accomplished by the shop instructors has more than paid for their salaries. The shop foreman, relieved of the care of the boys, can give their time to the more important details of the work.

Reports from the ten shops where apprentice schools have been established on the New York Central Lines show that in every case the boys are not only turning out a better grade of work than ever before, but that they are working on machines, or doing bench work, that formerly it was not thought possible to entrust to apprentice boys.

Another important advantage is that the apprentice, after he has had a few months of class room instruction, can read simple working drawings, and the third and fourth year apprentices become adept in reading the most difficult drawings. When one stops to consider the comparatively small number of so-called mechanics in the average railroad shop who can read working drawings readily, and the necessity of being able to do this, its importance can be realized. Not only this, but the boys are able to make sketches, or drawings, of shop devices or of broken parts, which it is often times advisable to have for record ac the local shop or for transmission to the mechanical engineer's office. During the past year the apprentices of the New York Central Lines made 1344 drawings which have been placed in the files of the New York Central Lines drawing rooms for use and record.

The criticism may be made that this work will unfit the boys for remaining in the shop. A certain percentage of the boys will, of course, wish to be transferred to the drawing room, but anyone who is familiar with the difficulty of securing satisfactory draftsmen for a railroad drafting room, who have had the necessary shop experience to handle the work required of them to advantage, will realize that it is very desirable to have a few of the boys graduate from the shop to the drawing room.

It is often desirable to conduct tests of tools or devices, or to determine the efficiency of various kinds of machines or other apparatus. The training which the boys have received in the class room has enabled a number of them to be used to great advantage during the past year in assisting on or conducting such tests. The benefit to the apprentice and the company is mutual.

Another effect of the new system is the better discipline over the boys and the effect which this has had on the shop as a whole.

At several of the shops the boys have organized apprentice or debating clubs. It is the practice to prepare papers on different topics and to discuss them. The class room training helps the boys to take part in these meetings and has been the means of developing them to a considerable extent. This, in connection with the local baseball teams, which have been formed at three or four of the shops, has done much to establish a co-operative spirit among the apprentices and also to get them more interested in their work and in closer touch with the men.

At several shops where it was formerly hard to obtain enough apprentices or to get a good grade of boys, little difficulty is now experienced, as the boys are assured of being given a thorough training in the trade and of having greater opportunities of advancement than formerly.

It has been the practice for apprentices to occasionally make visits to neighboring shops of other roads or to some of the other shops on the system. This has had practical results, as indicated by the following extract taken from a report made at one of the apprentice instructors' conferences:

"Several of the boys obtained ideas which they put into use at once; one boy who was working on a boring mill changed the method of fastening the tires on the table to correspond to the methods he had seen at Schenectady. He did this without waiting for definite directions from the instructor, and soon found that he was able to gain one tire in his day's work. The impression made on the minds of the boys by observing the methods of experienced workmen prove much more lasting than when these same methods are explained ever so clearly by their instructors. It is a paying proposition to the company to allow either boys or men to visit other shops where work of a similar kind is being carried on.

"The boys, after the above mentioned trips, were asked to write letters to the shop foreman as to their observations and what they had learned. These demonstrated the benefits which were gained."

The workmen are in thorough sympathy with the new movement. They realize that their sons are to have a better opportunity than they have had. The labor unions have given the movement their endorsement, as indicated by the following abstract taken from an address by James O'Connell, President of the International Association of Machinists, before the Civic Federation of New England:

"Summing up the whole question of industrial education, as it is supposed to apply to the young men, I am firmly convinced that every precaution should be taken concerning such schools (trade schools), to the end that young men will not be induced or led to believe that after serving a few months, or a year if you will, in an industrial or trades school, by securing certificates they are permitted or even warranted in going into the industrial field seeking employment as mechanics, against the best interests of those who have served a reasonable or legal apprenticeship. To avoid this danger, and with a view to securing the highest skill, and to perpetuate the supremacy of the American mechanic, I believe that the proper and best methods to be adopted are for employers to establish schools in connection with their factories and workshops, for the purpose of giving young men employed by them an opportunity for a few hours' schooling each day, in addition to the practical experience they are securing while serving their time as apprentices. To my mind this idea is best carried out by the New York Central Lines, as represented by Mr. Deems."

## BIBLIOGRAPHY.

The following bibliography has been arranged for those who may wish to look further into the question of modern apprenticeship. It includes a few of the more important articles which have appeared during the past three years:

"Technical Education of Railroad Employees—The Men of the Future." G. M. Basford. Master Mechanics' Proceedings, 1905, page 174. Forcefully points out the needs of improved methods of apprenticeship. Shows where the older methods have failed and oultines the general principles which should underlie a successful system under present conditions. The paper was very thoroughly discussed.

"A Plan to Provide for a Supply of Skilled Workmen." Magnus W. Alexander. Proceedings of the American Society of Mechanical Engineers, November, 1906. Outlines the training given by the General Electric Company at the Lynn works and gives suggestions to manufacturers for providing a supply of skilled workmen.

"Modern Adaptations of the Apprenticeship System." O. M. Becker. Engineering Magazine, December, 1906. Reviews the difficulties in securing skilled mechanics and the systems adopted by a number of concerns for training and educating the men.

"Technical Education of Apprentices in Connection With Actual Practice." L. M. Dolan. Proceedings of the St. Louis Railway Club, January, 1907. An account of what has been done at the Missouri Pacific shops at Sedalia.

"Real Apprenticeship." G. M. Basford. American Engineer and Railroad Journal, June, 1907, page 229. A study of some of the basic principles of a sucessful apprenticeship system.

"The Land of Opportunity." Harper's Weekly, June 27th, 1908. Describes the New York Central Lines' Apprenticeship System.

"The Apprenticeship System of the New York Central Lines." C. W. Cross and W. B. Russell. Master Mechanics' Proceedings, 1907, page 78. Presents a general description and outline of the system.

"A Rational Apprentice System." R. V. Wright. American Engineer and Railroad Journal, June, July, September, October and November, 1907. Presents a complete detailed study of the New York Central Lines' apprentice system and an abstract of the first apprentice instructors' conference.

"Industrial education," W. B. Russell. Proceedings of the American Society of Mechanical Engineers, October, 1907. A general description of the apprentice system on the New York Central Lines.

"Co-Operative Courses in Engineering at the University of Cincinnati." Herman Schneider. Read before the Society for the Promotion of Engineering Education. Gives an account of a course in which the student's work is alternate weeks in the engineering college of the university and in the manufacturing shops of the city.

"Grand Trunk Apprentice System." R. V. Wright. American Engineer and Railroad Journal, January, 1908. A detailed description.

"Apprenticeship." Committee report before the Master Mechanics' Association, June, 1908. Reviews the progress which has been made during the past year and recommends that the apprenticeship code of 1898 be discarded and that certain basic principles should be adopted as recommended practice by the association in its place.

"The Future of the Apprentice." R. I. Graves, an apprentice at the Chicago and Northwestern Railway Shops. American Engineer and Railway Journal, September, 1908, page 345. Gives an apprentice's idea of the opportunities which are open to him.

"Report of Second Annual Conference of Apprentice Instructors, New York Central Lines." American Engineer and Railroad Journal, October, 1908.

National Society for the Promotion of Industrial Education. The name of this society expresses its purpose. It was organized November 16th, 1906, and has issued several bulletins, which may be obtained from the Secretary, 546 5th Ave., New York City. One issued July, 1907, is a selected bibliography of industrial education; another issued September, 1907, gives a symposium on industrial education. The last two bulletins, Nos. 5 and 6, give the proceedings of the first annual meeting of this organization, which was held in Chicago.

The pamphlet, "A Rational Apprentice System," referred to above, will be sent to those interested in the details, on request.

PRESIDENT: Everybody who has had anything to do with the operation of shops during the past few years realizes the necessity for a rational apprenticeship system. The scarcity of skilled mechanics has made itself felt all over the country, and when one did succeed in securing a sufficient number of men who claimed to be mechanics it was generally found that the majority of them fell far short of being entitled to this designation. This is largely the fault of manufacturers and shop managers, owing to the practice of developing specialists in machine shops who could only handle one machine or one line of work, in place of bringing up a sufficient number of apprentices and developing them as skilled mechanics to take care of the work in the shops, and while there is no doubt that the specialist is here to stay, particularly in large manufacturing plants, there is an ever increasing demand for skilled all-around mechanics to build and maintain the machinery operated by the specialists in the large shops, and to do the general run of work in the smaller shops.

The time is ripe for manufacturers, as well as railroad managers, to seriously take up the question of a comprehensive system of education for apprentices in the mechanical trades.

The question is now before you, and I hope we will have a very free discussion, and would like to hear from representatives of the various railroads and of manufacturing concerns as to what they are doing in the way of apprentice education, and what they hope to accomplish.

MR. F. J. REEVE: I think I voice the feeling of the entire Club when I say I have been very much interested in this paper this evening. I have not had a great deal of experience along this line, yet I well remember my apprenticeship days. I only wish I could have spent them under such favorable auspices as Mr. Cross speaks of. I am sure that if I were going to do it over again I would secure the best technical education I could get and then I would serve an apprenticeship in a railroad shop, if I intended to follow railroading.

I remember the shop in which I served my apprenticeship, and I know that a good many of us were like the man who had a horse to sell, or rather like the horse he had to sell. He hitched him up one day to a buggy to show a prospective purchaser. Every little way the horse would stop. The buyer looked at the owner and said, "What is the matter with that horse?" "Well," he said, "there is nothing the matter with the horse, only he is so afraid some one will say 'whoa' and he won't hear it, that he stops to listen." A great many of us were afraid the clock would strike six and we wouldn't hear it, so we waited around for it.

I do not believe that if the apprentice has his heart in the work he will do that, and I am therefore a great believer in manual training in the public schools. If we would support that more the young men, when they get into the shops, would feel better satisfied in their own minds what course they want to pursue, and in the manufacturing and railroad plants they would not have to weed out so many of them.

PRESIDENT: Mr. Sweeley, could you tell us anything about the system they have on the Pennsylvania? They have a very elaborate system in some of their shops.

MR. G. P. SWEELEY: I am fully in accord with the system. I do not know that I could add anything more to the paper.

MR. GEORGE E. GIES: I would like to ask Mr. Cross to give us a little idea as to how to start, that is to say, in the car department, how long they have them on the different classes of work, how long they have them serve, and what their rates are.

PRESIDENT: If there are any other inquiries, Mr. Cross can answer them all together.

MR. JEWETT COLE: I would like to ask Mr. Cross if the New York Central has anything corresponding to the special apprentice course as they have it at Altoona, that is, what provision do they make for technical graduates coming into their shops and going through an apprenticeship work.

PRESIDENT: That is a point about which there has not seemed to be very much information given out. Could you tell us something about the apprenticeship system as applied to the special apprentices on the Pennsylvania system, as to just what it consists of?

MR. JEWETT COLE: In order to enter as a special apprentice the first condition would be that they are technical graduates. I can't say exactly what the course is now. It has been revised since I served my apprenticeship, and I could not say exactly what it is at the present time.

PRESIDENT: I understand that the Westinghouse Electric Company has a very complete system of apprenticeship. If there are any of their people here tonight we would like to hear from them. We want all the information we can get. Information is certainly needed as there are not enough apprentices to meet the demand.

MR. E. A. CRAIG: Since no one seems to answer up for the Electric Company, I am sorry I cannot myself give the information. If you would call on Mr. Buenting, he might tell you something of the apprentice system of the Westinghouse Air Brake Company.

MR. O. W. BUENTING: I do not know that I can give you any very complete description of the Westinghouse Air Brake apprentice system. It is, to quite an extent, similar to the system described in the paper tonight. We have about 24 apprentices at present. They are required to attend a certain number of classes during the week, and there is a regular technical course, consisting of mathematics,—arithmetic, algebra, geometry, etc.,—as well as mechanical drawing, and a regular outline of work for the shop which they follow through. The course consists of four years. Mr. Richardson, who has direct charge of the apprentices as far as their technical work is concerned, is here and could no doubt give a complete outline of their course.

MR. F. M. M. RICHARDSON: I might add only this to what Mr. Buenting has said, and that is, that the Westinghouse Air Brake Company has a close relation to the Young Men's Christian Association, and has opened to the Association the new welfare building at Wilmerding. The Association conducts this as an agency for the Company, and the educational director of the Association has charge of the apprentice school. The boys come to the Association building, which is only a few minutes' walk from the shops, on three mornings of the week, spending 7½ hours weekly in classes. They have mathematics, including arithmetic, algebra and geometry, mechanical drawing, mechanics of physics and a brief course in chemistry. We have a laboratory so that each boy is able to perform his own experiments in physics and chemistry. The apprentices attend classes during the four years of their indenture. The scholastic record of the apprentices is kept at the Association and is also sent quarterly to the superintendent of apprentices and this record is compared with the shop record, as an apprentice's scholastic record counts for or against him just as his shop record does. Also in indenturing apprentices it is the custom of the Company to determine whether or not the apprentice desires to take advantage of the educational opportunitites offered. When it is found the applicant does not care for such advantages it is thought better to give the place to a boy who does desire such schooling.

We have so far been able to secure boys who have finished the eight years of the public schools almost without exception; some, however, have only finished seven years.

The foregoing is our general apprentice course. In addition to that we have a Special Course in Mechanics which is designed for apprentice graduates, that is, for boys who have served their four years of indenture and who desire to take advanced special work. Such work is designed to give them some higher mathematics and other advanced subjects, and they are given the opportunity to do special work in the shop and in the engineering and testing departments for three years.

PRESIDENT: Might I ask just what the educational requirements for admission are; is it necessary that the boy shall have completed seven years in the public schools?

MR. RICHARDSON: We determine how far a boy has gone in mathematics and we usually find that he has reached square root in arithmetic. Some boys have finished arithmetic. After the boy is indentured he is given a rapid course in shop mathematics, making the arithmetic just as practical as possible, thus assuring ourselves that he has a good groundwork in arithmetic before he is allowed to receive instruction in algebra and advanced branches of mathematics.

PRESIDENT: Mr. Turner, you have charge of a shop where a number of apprentices are employed; could we hear from you?

MR. L. H. TURNER: I am afraid what I have to say will meet with some objections, as I have found that to be the case where my sentiments have been expressed elsewhere. I have everything to say in praise of the system inaugurated by the New York Central Lines, as has been explained to us by Mr. Cross this evening. I presume that my views of the practical value of technical education have been narrowed somewhat from the fact that all the education I ever obtained in schools was concluded when I reached the B. grammar class of the public school in a country town.

My remarks are intended to apply strictly to railroad shops, although they might apply to manufacturing plants as well. Mr. Cross has stated that the object of this school is to recruit the mechanical forces. The real object, it seems to me, is to develope men who will be fitted to take charge of shops. One of the most difficult problems that railroad mechanical department heads have to contend with to-day is to find suitable men to take charge of the work. Many years of observation lead me to believe that a young man with a fair knowledge of the lower mathematics and a fair draftsman and master of his trade, with executive ability and a knowledge of human nature, makes the best superintendent.

The young man who takes the course as carried out by the New York Central Lines obtains his mental training at the same time he gets his manual training, and during this time he is unconsciously absorbing another knowledge equally or more important than those mentioned, viz., that of fully understanding the men with whom he works.

The qualities necessary in the man to take charge of our shops have materially changed within the last generation. The time was when the officer was vested with the authority of arbitrary dismissal, and the employe had no recourse; but to-day he meets with the most prompt and strenuous opposition on the part of the shop committees, backed by labor organizations of which the employe may be a member. It makes no difference whether the man deserves his dismissal or not, he receives their support just the same.

The successful shop manager must, in the first place, be fully informed of all operations of his department to the minutest detail in order to combat successfully the fallacious statements and arguments that will be presented by the labor committees who largely depend on the ignorance of their superior officers in matters of detail to get their demands, just or unjust, granted. He must, by his complete knowledge of his work, be able by argument to convince the conservative and sensible element under his charge of the unjustness and unreasonableness of those under his command, and in no other way can he defeat those who assume to be leaders, and whose stock in trade consists of mediocre ability as mechanics, a ready tongue, and a loud voice. It may be said that too much importance is placed on the influence and power of labor organizations, but the condition is with us and must be met, and the sooner we get out in the open and declare our principles that our men shall be used right, shop conditions made as pleasant as possible, current wages paid, and no unfair advantage taken of the men, and in return for this we must have sobriety, loyalty and a full day's work for a full day's pay, the sooner will strikes, lock-outs, depleted equipment, disrupted organization, and suffering among workmen and their families be a thing of the past; and the man to bring about this condition is the one who has been raised among them, but blessed with the ambition and energy to take advantage of the opportunities offered and in this way educate and prepare himself to become their leader. His long years of association with them makes it possible for him to understand their desires, ambitions, processes of reasoning, as well as cupidity.

While I in no way disparage technical training, I do believe that the young man who has spent the first twenty-five years of his life in preparatory schools and universities, with all the advantages of refined associations and the disadvantages that are sometimes found in college societies, undue indulgence in athletic sports, mandolin clubs, cigarettes and chorus girls, is not fitted after six months or a year's special apprenticeship to meet the conditions that are found in every railroad shop in the United States to-day. It is true, there are exceptions. It has been my pleasure to meet men just out of college who realized that their education had just commenced, and that in order to meet requirements they must go to the bottom and work their way up, and the man who has the sense to do this, has the sense to work hard on his trip from the bottom to the top, and to bridge the chasm that has and always will separate the refined and educated man from the coarse and uncultured one, not necessarily to make him his social equal, but to understand him; and the successful man of this age is the one who can influence and control the other fellow, and this must be done by convincing arguments, firmness, moral suasion, fair and open dealing, and not with the big stick. To convince a man you must understand his feelings and sense of justice and appeal to them. The types of mankind vary, and a perfect understanding of any particular type is only gained by long years of association, and this is why I say that the man who obtains his mental while getting his manual training, and at the same time obsorbs a complete knowledge of his associates, makes the strongest man as a shop manager, and the man who is big enough to make a successful manager of shops is also big enough to take greater responsibilities, as is evidenced by the great number of men who hold the higher positions in the railroad world to-day who have had their earlier training in and have risen from the mechanical department.

PRESIDENT: I see quite a number of apprentices from the P. & L. E. shops here. Some served a part of their time under the old conditions and a part under the course outlined by Mr. Cross. Possibly some of the boys might be persuaded to say something as to whether they think there is any advantage in the course they are now being given. Mr. Cooper, can you say something about the system as applied to your own case?

MR. E. E. COOPER: I began under the old system, before the New York Central Lines took charge of the Lake Erie and inaugurated the present School of Instruction. I have been with it until lately, and find it very helpful in a good many ways. For one thing, it teaches mechanical drawing, and by teaching mechanical drawing it teaches apprentices to read blue prints, and from that they can lay out work very readily and also very carefully, because the instructions an apprentice gets in the constructing room teaches him to be very careful. Another thing is the mathematics. The mathematics he gets brightens him up in a good many ways, especially in shop practice. Another thing is the instruction the apprentice gets in the shop. It used to be that an apprentice served his time under the old system, and when he got a job and wanted to know how to understand it he went to the foreman, and probably he was busy and could not show him right away, and he would ask the man next to him, and if he knew possibly he would show him and probably he would not—at least a good many did not like to tell the apprentices what it took them years to learn. By having the shop instructor, when the apprentice gets up against it all he has to do is to go to the shop instructor and it is explained to him right there, and it is very easy for him to do it after that.

I fully believe that if an apprentice goes through the course inaugurated by the New York Central Lines he will have no trouble whatever in holding a position as a machinist in any locomotive or railroad shop or contract shop in the country.

PRESIDENT: There are quite a number of men here who have worked in a machine shop and can realize the force of what Mr. Cooper said. Mr. Gardner, who is the assistant of Mr. Cross, is here and he ought to be able to tell us something about it.

MR. HENRY GARDNER: I have been so recently associated with Mr. Cross in this work that I hardly feel competent to talk at length on the apprenticeship system. I might speak from the standpoint of instructor in the McKees Rocks shop. While I was at McKees Rocks, I had charge of about 36 apprentices and can speak with assurance as to the advantage, both to the company and to the boys, due to this training. It is demonstrated in a good many ways. It is shown by the increased efficiency spoken of in the paper and also by Mr. Cooper.

Mr. Cross' paper might be amplified a little as to the course by saying that it consists of mechanical drawing, primarily the foundation course, and arithmetic. The arithmetic is written in such a way that the problems are all found in shop work, illustrating shop practice and shop principles. Also, in addition, we have a laboratory, where we have a small upright engine, lathe, injector, pump, etc., for teaching all the mechanical principles that can be taught in a laboratory of that size. The work is carried on in the laboratory during the regular hours, and the classroom instructor has an assistant who takes charge of that work. I notice that the gentleman who spoke about the Westinghouse system spoke of physics. We think of having physics in a small way, also testing, to show the strength of materials and strength of beams in tension and compression, and similar work along this line; not too technical, but enough to teach the boys these mechanical principles.

MR. HENRY F. GILG: Something came to me to-day accidentally which will bear on the importance of the training. In the office of a friend I saw two sets of examination papers, one for mechanical draughtsmen and one for engineers. In the answers of some twelve or fifteen applicants for mechanical draughtsman there was not a single one who could make a drawing for a foundation for a boiler; not a single draughtsman who could show details for a flywheel necessary for making and preparing and finishing it. There was not one who showed the proper proportions and finishing up of a crank shaft. In the engineers' papers there was only one man out of about twenty who answered all the questions. In all cases they were rudimentary questions that every man who has been around a workshop ought to know. This struck me as something that is deplorable on the part of men, some of whom had been engineers for 20 or 25 years. One of them had been on a railroad for twelve years. It would seem to indicate that the railroad and industrial concerns who are teaching their apprentices are on the right line. It is also up to the apprentices to get the full advantage of the opportunities that are presented to them. They can not tell what day they may be in the position of one of the men who answered the first question in the examination for engineers, on the different kinds of valves, by saying that he had to have a job. He could not answer any of the others, apparently. One of the papers was turned in without a mark except the indorsement "quit" by the examiner. I have no doubt that the methods that are being pursued will change this in the course of five or ten years.

MR. F. H. STARK: I would like to ask Mr. Cross whether they have any required physical qualifications, whether they seek boys belonging to employees in order to build up the railroad organization by taking care of their own, and whether the course they give is equal to the completed course in the International Correspondence School. I am like my friend Turner—I grew up like Topsy. But I appreciate how much I have been handicapped. The young man who takes advantage of his opportunities and behaves himself will without doubt receive reward. I call to mind a big Irish boy at Lorain who took up the International Correspondence School System. After his four years of apprenticeship he went directly to the Shelby Seamless Tube Company and took charge of the tool department at something like $4 a day. He remained there possibly two years, when he was transferred to another place as master mechanic. I call to mind another young man who started in with the New York Central Lines only a few years ago and is now one of the division master mechanics, and some day will be superintendent of motive power of some road, if not the New York Central. We have another case of a superintendent of one of the mines of the Pittsburg Coal Company, a son of a Frenchman who has worked in the mines ever since he has been in this country. The boy took up this correspondence school course and passed the best examination as required by the State Mine Inspector and was promoted to pit boss, and only served in that capacity a few months when he was made superintendent of three of the largest mines.

The great trouble with most young men is that they fail to appreciate their opportunities; they lack stick-to-it-iveness, and fall by the wayside because they think they are not promoted fast enough. There is always an opening for the right kind of a young man, as Mr. Turner says.

MR. A. STUCKI: Mr. Rockefeller says that the boy of to-day has a better chance than what he and his playmates had, and after listening to this paper I think, generally speaking, that this is correct. But ,as Mr. Gardner mentioned, it is not only the boy that gets the benefit of this kind of schooling, but the firm or the railroad company gets its share as well. Take, for instance, the drawing room. I am not speaking of theoretical researches or original designs, but have more reference to ordinary detailing, every-day practical designing for shops and railroads. Here, it is my experience, that the boy who has come from the shop and has gone through such a school, after a little office experience makes the very best kind of a draftsman for all kinds of work. Of course, I admit, these apprentice schools do not show results the first day. They are like many other establishments, where we have to put in money a good while before we get returns. But the returns are sure to follow.

PRESIDENT: If there is nothing further, we will ask Mr. Cross to close the discussion.

MR. C. W. CROSS: Those of us who have served an apprenticeship at any one of the mechanical trades will remember with just a slight tinge of regret that we did not get much of a show. The principal instruction we received with regard to the practical part of the work was backed by the use of a No. 9 boot. We will especially appreciate any efforts that are made to improve conditions under which we learned for our apprentices at the present time. I will try to answer the questions in order. Mr. Gies asked in regard to the course for the car department. I have a pamphlet here for distribution, and there are more where these came from. The course in detail as given in the regular list does not mean anything in particular unless it is considered in connection with the shop instructor to follow up the boys and see that they are moved in accordance with the schedule and are given a good opportunity to learn. The first course in connection with the car department is the pattern shop. The schedule reads, "general helper" in that department for the first three months. Then in the foundry for three months, or with a maximum of six months, depending on the nature and extent of the work. Then operating machines in connection with the pattern work for three months, with a maximum of twelve. Next on regular bench work the balance of the time of the three years' course. After this in the planing mill general helping from the start up to a limit of four months, wherever he could be used to advantage. You could not have a regular specified course on account of the differing conditions. Then in the next twelve months, with a maximum of 24, running different machines in the planing mill and sharpening tools, setting tools, etc. In the next bunch are more complex machines, including sharpening and setting tools. The last part of the course is laying out working templates and working from drawings. We have also a car builder apprentice.

In regard to the rates, that is a local affair depending altogether on geographical conditions. It should be understood that the New York Central Lines is not one company, as a number of you know, but is a mere name. Therefore, the rates are under the control of each of these particular lines that comprise the association. The same applies to rates for everybody as well as apprentices.

Mr. Cole asked in regard to special apprentices. Our practice is to drop the word "special"; all the apprentices taken are called "regular" apprentices. But to take care of a young man who has had previous experience in a school or shop such as in the opinion of the employing officer entitles him to consideration, he can be given allowed time up to a maximum of two years and start in under the maximum arrangement as a third year man and serve a two-year course. We feel that if the young man has information or knowledge that is commercially valuable, it does not matter particularly where he got it, he can sell that knowledge for money.

Mr. Stark asks about the physical examination. The practice is for the apprentices to pass the same examination that is given to any employee. It is based largely on the U. S. Army requirements, which is the American Railway Association practice. But the employing officer can waive some features of it. An apprentice is not called upon to perform service where he would get into any trouble if he is slightly color blind, and if, after several years, he should wish to enter the train service, it is likely he would have to stand another examination at that time anyhow. The local officer sends him to the company surgeon, and when the report comes back if the local officer wishes to waive a portion of it he can do so. But that prevents any chronic invalids being taken on as apprentices.

Sons of employees are preferred in giving employment in the apprenticeship system. As regards comparison with the International Correspondence School course, it would be difficult to say how it compares, unless we could be very specific as to what particular part is referred to, as they have a variety of courses. Our lesson papers are being written by Mr. Gardner as we go along and being made to suit the conditions under which the work is being carried on, having it closely connected with the operation of the shops, the object being to teach the boys the theory of the business at the same time they are learning the practical part. We do not know how far we will go, and it is a question how far we ought to go. We do not want to make scientific engineers out of all the boys, we want to make mechanics to recruit the shops; and for those who can go farther there will be room also. We are working for the great rank and file with the object of having, as was said in an article some time ago, "a light crop over a large area rather than a phenomenal growth of a few plants."

A VOICE: I would like to ask one more question, if the New York Central has any difficulty in obtaining blacksmith apprentices?

MR. C. W. CROSS: At some points, yes; at others, no;

depending on the location of the shops a good deal. Shops located in a village where the whole community is interested in the shops, and the workman in the shops may have a brother that is a banker and a brother-in-law that is a grocery keeper, that is generally a community where the boys come right together in the trades naturally; they fit right into the business. But for a shop located at the edge of a large city it is very difficult to get boys in the boilermaker's trade and the blacksmith trade. Those we get seem to have some sort of notion that the machinist's trade is an easy snap—but I have not found it so. The blacksmith trade is one in which a young man can start up in business for himself sometime; but he can not with the machinist's trade. We try to get around that point by offering slightly higher rates to boiler maker apprentices and blacksmith apprentices.

I would say for the information of the members that on the New York Central Lines this work is in operation in ten shops with a total of about 500 apprentices, and it is the intention to extend it to other shops a little later and take care of the small shops as well as the larger ones. Recently we have been testing a plan at St. Thomas, Ont., on the Michigan Central Lines, of providing for a small shop without having the matter too expensive. We found we could do that at St. Thomas with 36 apprentices, by having one young man take the position of shop instructor, drawing instructor and shop draughtsman, all as one individual, where there had been no shop draughtsman before. This works out very nicely. The draughting room is kept open all day by student draughtsmen located in the room who give out drawings as required, make sketches, etc., as part of his regular course. They all have a little turn in the drawing room while the instructor is acting as shop instructor.

MR. F. H. STARK: I am sure we have all enjoyed the address given by Mr. Cross, and we appreciate his coming so far to address this Club. I move that we give him a vote of thanks for the talk he has given us, and thank him for coming here.

The motion, being duly seconded, was carried unanimously.

The report of the Nominating Committee was then submitted, as follows:

| | |
|---|---|
| For President, | D. J. Redding.<br>J. F. Prendergast. |
| For First Vice President, | F. R. McFeatters.<br>H. B. Ayers. |
| For Second Vice President, | Wm. Elmer, Jr.<br>George Gurry.<br>A. G. Mitchell. |
| For Treasurer, | J. D. McIlwain. |
| For Secretary, | C. W. Alleman.<br>G. H. Davis. |
| For Executive Committee, | L. H. Turner.<br>F. H. Stark.<br>Geo. T. Barnsley.<br>G. P. Sweeley.<br>A. Stucki. |
| For Finance Committee, | D. C. Noble.<br>Stephen C. Mason.<br>C. E. Postlethwaite.<br>E. W. Summers.<br>A. B. Bellows. |
| For Membership Committee, | D. M. Howe.<br>C. A. Lindstrom.<br>W. V. Turner.<br>A. L. Humphrey.<br>M. A. Malloy.<br>R. A. Bole. |

ON MOTION of Mr. Stucki, the report is accepted, with thanks, and the Committee discharged.

ON MOTION, Adjourned.

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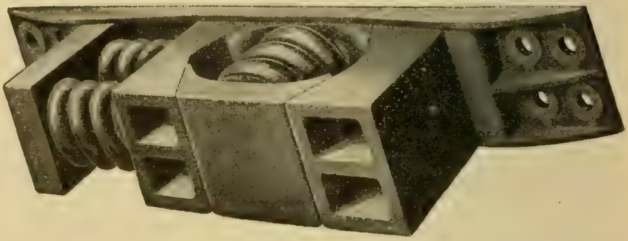

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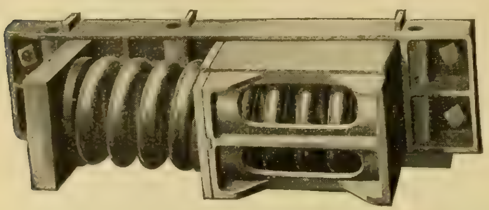

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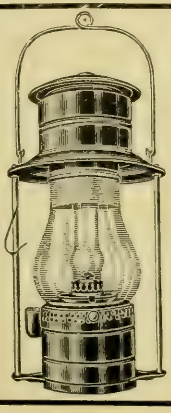

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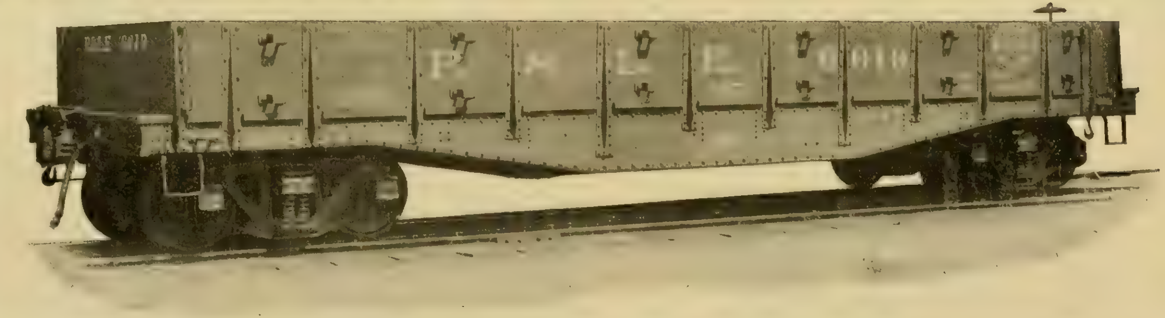

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¶ Steel Boiler Tubes have been found to be not only better, but also cheaper than Charcoal Iron Tubes, and it would seem wise for the present users of Charcoal Iron Locomotive and Stationary Boiler Tubes to order sample lots of the Steel Tubes and satisfy themselves as to the correctness of our statements as to quality and price.

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¶ Steel Boiler Tubes are in use at the present time on many of the large Railway Systems of the United States; they are also used in the construction of Stationary Boilers by all the large Boiler Manufacturers, and the demend from both sources is constantly increasing. The U. S. Navy has adopted the Steel Tube as their standard. These statements should be sufficient to convince anyone of the fact that the Steel Boiler Tube has largely superseded the use of the Charcoal Iron Tube (due to both quality and price).

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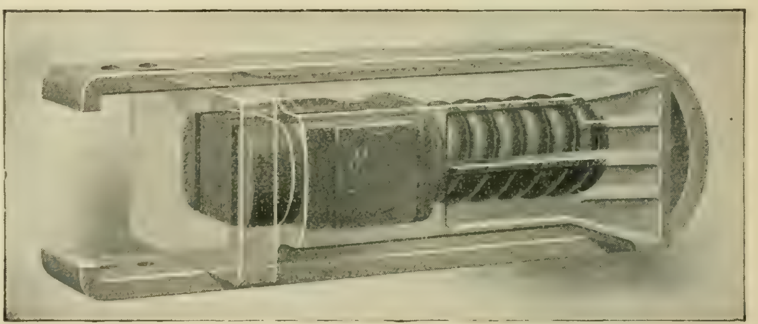

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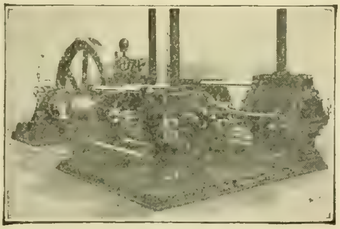

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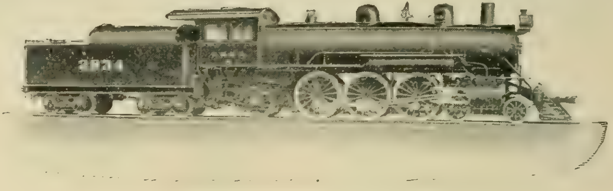

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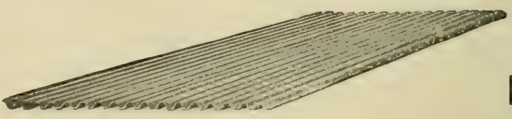

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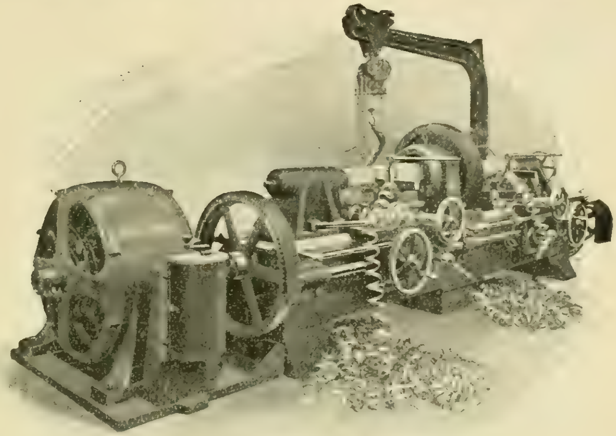

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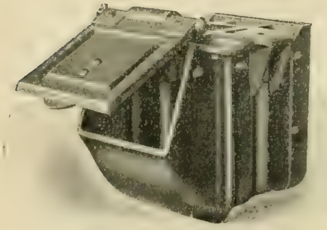

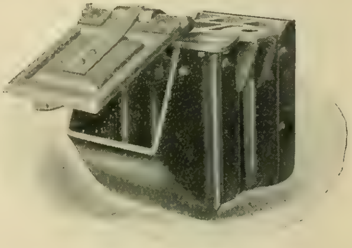

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ORGANIZED OCTOBER 18, 1901.

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VOL. VII.
No. 9.

**Pittsburgh, Pa., October 23, 1908.**

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Published monthly, except June, July and August, by the Railway Club of Pittsburgh, J. D. Conway, Secretary, General Offices P. & L. E. R. R., Pittsburgh, Pa.

*Meetings held fourth Friday each month, except June, July and August.*

## PROCEEDINGS OF ANNUAL MEETING,

## OCTOBER 23rd, 1908

The meeting was called to order at the Monongahela House, Pittsburgh, Pa., at 8:30 o'clock, P. M., with Vice-President D. J. Redding in the chair.

The following gentlemen registered:

## MEMBERS.

Alleman, C. W.
Allen, Harvey.
Ault, C. B.
Ayers, H. B.
Barnsley, Geo. T.
Bealor, B. G.
Bigham, Chas. G.
Bihler, L. C.
Blest, M. C.
Brand, Thos.
Brown, Geo. P.
Brown, John T.
Brownscombe, G. J.
Chapin, E. S.
Chittenden, A. D.
Colburn, Wm. W.
Conway, J. D.
Coulter, A. F.
Crawford, H. M.
Crouch, A. W.
Cunningham, J. D.
Dawson, W. J., Jr.
Edmonds, J. F.
Elder, T. W., Jr.
Falkenstein, W. H.
Fischer, Chas. L.
Forsberg, R. P.
Frank, Laurence W.
Gale, C. H.
Gallinger, Geo. A.
Gano, J. H.
Gearhart, H. J.
George, M. E.
Gies, Geo. E.
Hackenburg, J. H.
Halleran, H. J.
Henderson, J. W.
Hughes, J. E.
Hunter, Harry S.
Huyett, E. G.
Jackson, C. A.
Johnston, Lucius S.
Kaup, H. E.
Kessler, D. D.
Keyser, R. H.
Kinter, D. H.
Klee, W. B.
Knickerbocker, A. C.
Knight, E. A.
Koch, Felix.
Koch, H. J.
Krause, Julius.
Lambe, G. C.
Lanning, C. S.
Lanning, J. F.
Lehr, Harry W.
Lindstrom, Chas. A.
Lobez, P. L.
Loudenbeck, H. C.
Lowry, R. N.
Lynn, Samuel.
Maguire, W. E.
Marshall, C. A.
Mawhinney, W. J.
Millar, C. W.
Miller, F. L.
Murphy, W. J.
McClumpha, H. E.
McFeatters, F. R.
McIlwain, J. D.
McKee, F. E.
McKee, Frank W.
McKee, S. Frank.
McKee, Ira E.
McNulty, F. M.
Newsom, H. H.
Oates, Geo. M.
Oneal, J. E.
Orchard, C.
Peach, W. M.
Pfeil, John.
Phelps, W. H., Jr.
Porter, H. V.
Postlethwaite, C. E.
Quest, W. O.
Randall, E. J.

Redding, D. J.
Rider, J. B.
Rinehart, H. W.
Robinson, F. M.
Sattley, E. C.
Scheck, H. G.
Schomberg, Wm.
Sellers, C. E.
Shannon, Chas.
Sitts, Lewis S.
Smith, D. W.
Stafford, Samuel G.
Stark, F. H.
Stucki, A.
Suckfield, G. A.
Swartz, H. E.
Sweeley, G. P.
Tate, R. H.
Taylor, H. G.
Townsend, T. E.
Trinler, Chas. M.
Trust, J. F.
Turner, L. H.
Walker, J. W.
Warne, J. C.
Warnock, H. R.
Wilson, W. H.

## VISITORS.

Abrams, Geo. H.
Adams, E. C.
Baldwin, G. C.
Ammer, Frank.
Bateman, Paul.
Boyd, L. S.
Callahan, John.
Carlton, Herbert A.
Casey, Fred A.
Clark, C. C.
Clarke, W. R.
Coho, O. C.
Cole, W. C.
Congdon, W. J.
Cooper, G. E.
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Cunningham, C. H.
Currie, E.
Curry, E. W.
Dempsey, Harry J.
Ferree, H. W.
Fisher, H. B.
Fluke, K. L.
Gale, G. W.
Geissinger, D. F.
Gibson, Frank.
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Holt, T. W.
Howe, W. C.
Husband, Chas. M.
Johns, A. W.
Johns, Watson.
Johnston, C. L.
Kirby, J. G.
Knight, Arthur O.
Knight, Harry A.
Knowles, Chas. R.
Lamb, C. M.
Levy, J. Leonard, Rev. Dr.
Merrill, J. S.
McShrut, A. R.
Newman, John C.
Reynolds, R. S.
Rowan, W. H.
Schreiner, W. C.
Smith, Russell.
Smith, Sion B.
Stone, H. E.
Streib, J. F.
Thatcher, R. H.
Unts, John.
Van Horne, F. P.
Vauclain, C. A.
Walker, J. L.
Waterloo, Julius.
Wees, Otto.
Weller, Lincoln.
Wilson, N. V. F.
Winter, F. W.
Wright, L. S.

The Secretary announced the following proposals for membership:

Bateman, Paul, Car Estimator, Pressed Steel Car Co., 57 Bryant Ave., Bellevue, Pa. Proposed by W. M. Peach.

Hilberry, H. H., Asst. M. M., Penna. Lines, Allegheny Shop, N. S., Pittsburgh, Pa. Proposed by G. P. Sweeley.

Howe, W. C., Pressed Steel Car Co., Farmers Bank Bldg., Pittsburgh, Pa. Proposed by H. E. Swartz.

## SECRETARY'S REPORT.

To the Officers and Members of the Railway Club of Pittsburgh:

Gentlemen: In presenting briefly a statement of the events closing the seventh anniversary of our organization, I want to first thank the officers and members for the many kindly acts and courtesies extended me during the past seven years that I have served as your Secretary, and in tendering my resignation, want to say that it is done after a very careful consideration and I feel free in saying that at this time it should not in any way interfere with the success of the Club for which I shall always hold a warm interest.

The business depression during the past year has to no great extent, lessened the very loyal support derived from our good friends, "The Advertiser."

It is to be somewhat regretted that we are compelled to show so many members dropped for non-payment of dues, and it is hoped the members will discharge this obligation of their interest with promptness and dispatch.

Death removed from our midst during the year the following members which included our late President, Mr. H. W. Watts:

C. M. Fraser,
J. K. Kerr,
Richard S. Mercer,
Fred J. Shaler,
A. W. Slocum,
Antes Snyder,
W. W. Todd,
H. W. Watts.

The following is a summary of the membership, financial condition, etc., for the year up to and including this meeting:

## MEMBERSHIP.

| | | |
|---|---|---|
| Reported last year | 777 | |
| Received into membership during year | 107 | |
| Reinstated | ... | |
| | | 884 |
| Suspended, non-payment of dues | 92 | |
| Resigned | 31 | |
| Loss of address | 11 | |
| Removed by death | 8 | |
| | | 142 |
| Present membership | | 742 |

## FINANCIAL.

| | | |
|---|---|---|
| RECEIPTS— | | |
| In hands of Treasurer last year | $ 898.81 | |
| From advertisers | 882.75 | |
| From dues | 2,202.00 | |
| From sale of Proceedings | 85.33 | |
| | | $4,068.89 |
| DISBURSEMENTS— | | |
| Printing Proceedings, advance sheets, notices, etc | $1,459.32 | |
| Hotel, luncheon, etc | 508.25 | |
| Postage for Journals, etc | 289.83 | |
| Secretary's trip to Atlantic City | 50.00 | |
| Cigars for meetings | 98.89 | |
| Stereoptican light | 20.00 | |
| Stationery and supplies | 37.00 | |
| Messenger service | 17.50 | |
| Secretaries' Association dues | 20.00 | |
| Reporting Proceedings | 135.00 | |
| Miscellaneous | 32.75 | |
| Floral emblems | 30.00 | |
| | | $2,698.54 |
| Balance in hands of Treasurer | | $1,370.35 |

J. D. CONWAY,
Secretary.

Approved:

L. H. Turner,
F. H. Stark,
G. T. Barnsley,
Executive Committee.

## TREASURER'S REPORT.

Pittsburgh, Pa., October 23rd, 1908.

| | | |
|---|---|---|
| RECEIPTS— | | |
| Balance on hand from last year | $ 898.81 | |
| Received from Secretary during year | 3,170.08 | |
| | | $4,068.89 |
| EXPENDITURES— | | |
| Paid out on Secretary's checks | | 2,698.54 |
| Balance on hand | | $1,370.35 |

Respectfully submitted,
J. D. McIlwain,
Treasurer.

Approved:

L. H. Turner,
F. H. Stark,
G. T. Barnsley,
Executive Committee.

The Report of the Committee on Election of Officers was read by the Secretary, showing the following gentlemen elected for year 1908-1909:

*President,* D. J. Redding; *First Vice President,* F. R. McFeatters; *Second Vice President,* Wm. Elmer, Jr.; *Treasurer,* J. D. McIlwain; *Secretary,* C. W. Alleman; *Executive Committee,* L. H. Turner, F. H. Stark, Geo. T. Barnsley; *Finance Committee,* D. C. Noble, Stephen C. Mason, C. E. Postlethwaite; *Membership Committee,* D. M. Howe, C. A. Lindstrom, W. V. Turner, A. L. Humphrey, M. A. Malloy.

PRESIDENT: I think it unnecessary for me to say that I very much appreciate the honor of having been elected President of this Club. I might take up a lot of your time telling you what we have done in the past and what we expect to do in the future, but I think you will take our work for that and allow us to eliminate speeches as far as the officers are concerned, except that I think we ought to hear from that very able orator who has just been elected First Vice-President of this Club, Mr. Frank McFeatters.

MR. F. R. McFEATTERS: I will try to make a worthy successor to the present President, if you see fit to select me next year. (Applause.)

PRESIDENT: If there is no further regular business to come before the meeting, I will ask Dr. Levy to come forward, who is to make the principal address of the evening. I take pleasure in introducing the Rev. Dr. J. Leonard Levy, who will speak to us upon the subject,

# "YESTERDAY, TODAY AND TOMORROW."

BY REV. DR. J. LEONARD LEVY.

Mr. Chairman and Gentlemen: The theme which I have selected for this evening's talk is one which I hope will leave in its path that optimistic view which, I think, is an essential duty of every public educator to emphasize. More especially is it the duty of every man who undertakes to spread the gospel of justice and mercy and humility of spirit to enlarge upon it on every possible occasion and in every possible direction.

About seven years ago I found myself in the city of Cairo during a trip through the Orient, where I passed some days in the wonderful Museum at Boulak, about eight miles from the center of the city. This building was, at one time, the palace of the Khedive of Egypt, and under the direction of M. Mariette, the great French Egyptologist, the building was designed to become a museum in which was to be placed the most remarkable collection of Egyptian antiquities found under any one roof in the entire world. Room after room, and hall after hall, are fairly crowded with wonderful specimens of the wisdom of the ancient Egyptians. As I passed through the various rooms in that wonderful palace, and through its many halls, I could not help wondering at the skill of the ancients and at the patience and the splendid scholarship which have made ancient Egypt as readily understood by Egyptologists, as modern Pittsburgh is to you who investigate its conditions.

In one room, for example, I saw a model of the chariot in which the ancient Pharaoh pursued my ancestors to the banks of the Red Sea. In another room I saw the two oldest statues in the world, of the Princess Nepheret and her husband, statues carved from the stone of Egypt and colored to the life, bearing eyes of such wonderful workmanship that it is almost impossible to believe that they are not human eyes placed in these stone statues. In another room I saw bodies swathed in the fine linens of Sais, upon which were written the story of the life of the individuals bound in these solemn draperies of death. In still another room I saw scarabs, statuettes used as personal charms, even those of Isis, Osiris and Horus, the first trinity of the ancient gods of Egypt. Wherever I went I saw evidences of marvelous workmanship—jewels wonderfully polished and cut, golden ornaments of filagree pattern, some of them not less than 7,000 years old, and which would challenge the goldsmith's art of the present century. As I left these halls I observed that the king of modern times has borrowed his scepter from Egypt; that the theologies of many modern religions have borrowed their gods from the pantheon of Egypt; that my lady's boudoir has its combs and brushes and hand-mirrors taken from the ancient chambers of the Egyptian ladies; that the axle and the lever and the simple tools of the working man come to us from Egypt; and I could not help reflecting, as I gazed upon the great Sphinx and the wonderful pyramids in the distance, that the mother of civilization had followed the path of glory, only to find it the path to the grave.

Some months later I found myself in the city of Pittsburgh (the city of which it has been said that men here make iron and "steel" for a living), the city in which we find "the pillar of cloud by day and the pillar of fire by night,"—when times are good. I observed in this city, for example, that one end of it is bound to the other by the copper wires which afford not only the rapid transit we are supposed to get in Pittsburgh, but which are likewise the means of transferring messages from one friendly home to another. On the streets of Pittsburgh I saw free schools, free institutions of learning, free public libraries, free public parks, free hospitals. On the streets of Pittsburgh I found men of every hue and every religious denomination, almost touching hands as they pass in perfect peace. Here in Pittsburgh in this Twentieth Century I saw homes which are built with respect for personal cleanliness and personal decency, matters unknown to the ancients; and I could not help reflecting, when I once got into my own home here, that the story represented by the Boulak Museum is, as compared with the story represented by a modern Pittsburgh home, the story of 5,000 years of human progress, the story of Yesterday as compared with Today.

It has taken me just about five minutes to speak, under a few general heads of the yesterday and today. But it was not accomplished so readily as it may be described here. In fact, when I compare the wonderful progress which the human family has made within this period of 5,000 years I am reminded of the story of the American Fire Commissioner who had been sent abroad to investigate fire conditions in foreign countries. He happened to land in Dublin and visited a fire station there. He went to the fireman in charge and asked him what they did in Dublin when a fire occurred. This splendid son of Erin remarked: "You see," he said, "it's this way. When there's a fire in Dublin the boys comes and they tells us there is a fire; and we asks the boys where the fire is. And then we puts the boys on the fire engine and they show us the way to where the fire is; and then we comes to the fire, and we pours water on the fire, and puts the fire out. And we give the boys a shilling for showing us the way. But what do you do in America when you have a fire there?" "Oh," said the American, "when we have a fire in America some one presses a button, which starts gongs ringing all over the city in all the fire stations. The men who are in charge know from the number rung upon the gong the location of the fire. As soon as the horses hear the gong sound they leave their stables by themselves, run to the engines, and, quicker than it takes me to say 'Jack Robinson,' a fireman presses another button, the harness and saddles all fall in place, and in less than fifteen seconds the fire engine is on its way to the fire. Now what do you think of that?" "Well," said the Irishman, "I have heard tell that there were liars in America; but such liars as that I didn't think there was even in America."

And so, gentlemen, when we consider this wonderfully rapid development of human progress by contrasting the period of 5,000 years ago with the established progress of today, one is inclined to believe that our finding is the result of romance rather than of real fact. We have progressed; but we must always remember that progress is not made in a straight line. Compromises have to be made. Here defeats are met and overcome by others. Here men fall exhausted, stricken down because of their attempt to help the human family forward. The mountain stream coming from its top amid the snows, and pursuing its course to reach the ocean, is a fair representative of the line of progress. The meandering course which it is compelled to take, the difficulties and obstacles it has to brush out of its way, the thousand and one lines of opposition that it must overcome, before it can become the broad flowing river of the plain and a source of supply to the ocean, may fairly be taken to represent the opposition offered by the determination of the privileged classes in all ages to thwart the movements which have tended to the best influences and the real progress of society. The men, the chosen of the earth, who have been those who have most helped mankind, never calculated to escape this opposition exerted by the privileged few against the many. They have always manifested the stolidity of the little boy whose mother asked him, when he came home showing her a quarter, whether he had thanked the gentleman who had given it to him. Tommy answered his mother never a word. "Now, Tommy," she said, "do tell me if you thanked the gentleman who gave you that quarter." Tommy remained perfectly silent. Again the mother said, "Tommy, will you tell me whether you thanked that gentleman or not?" Not a word from Tommy. "Tommy, if you don't tell me whether you thanked that gentleman, I will lick the life out of you"; and his mother was an athletic lady who had attended one of the modern American women's colleges. She took her tender little boy and placed him across her knee, wrong side up, and her hand met his youthful anatomy with no gentle touch. When she was fairly well exhausted she said again, "Tommy, will you tell me whether you said thank you to the gentleman?" And Tommy finally answered: "Of course, mother, your son said thank you to the gentleman; but he said 'Don't mention it.'"

Martyrs had to die, heroes had to perish, teachers had to be sent to the stake, the savior of mankind had to be crucified, whole races of men had to have pressed upon their heads the crown of thorns, whole peoples were exiled and brutally treated by the nations of the earth before the definite and the determined intent of the earth's chosen could be established. Before men could understand the progressive movements those chosen of God had to become the rejected of men. But when a man has heard the call from on high; when he has seen God, as it were, face to face; when he has heard the voice of duty impelling him forward for the sake of mankind; he knows no sleep, he knows no rest, he knows no peace, his face becomes set, his jaw becomes firm. He can go out to die, but he cannot lie, and he cannot surrender. He feels that he is the chosen of God, and that human progress is at stake. He understands that if men would get the precious jewels from the earth they must be content to dig for them. It is the general proposition of the maid who would wear jewels in her ears;—she must pay the price of having her flesh bored if she would be thus beautified. The man who wishes to see the American Beauty rose knows that he must be content to destroy every bud on the bush in order that the entire force and beauty of that bush can flower into one blossom. So mankind, in order to obtain progress, has had to pay the price of that progress. Progress is as much a law operating on man as that trees should grow; and there is nothing more revolutionary, there is nothing more harmful to the growth of mankind, there is nothing more opposed to the natural and divine law, than that man should stand still while everything in nature is moving onward and calling to him to move with it.

Now there are men who constantly refer to yesterday and say that yesterday was better than today. They point to the fact that the times are out of joint. They curse the spite that they were ever born to set things right. They ever descant upon the times of their fathers and grandfathers. They talk about mother's bread and mother's pie, and mother's coffee. Such recalcitrant members of society are called by various names. I was told during the little dinner that I enjoyed so much before coming in here, that they generally call them, in this city of delightful society, "kickers." They ought to be called "the kicked," because that is what they deserve to be. There are men who, like Janus, have eyes in the back of their head; they see everything beautiful in the times that are past. But, unlike Janus, they have no eyes in the front of their head to look forward to the greater good that is to be tomorrow. If you go down a long street and observe the electric lights, you will notice those nearest you seem to be quite far apart. If you look at those a mile or so off, you will notice that they seem to be bunched. But as you approach the latter you will observe that they, too, are equally distant, just as were those nearest to you a few moments before. Distance lends enchantment to the view. The lady who was being made love to 30 or 40 years ago in the South was listening to the appeal of her lover, who said: "My heart goes out to you, and I want to ask you to be my wife." Under the spell and witchery of the moon, he continued, "See how beautiful it is tonight, my love." And she unsympathetically said to him: "Yes, the moon is beautiful; but you should have seen that moon before the war."

So in life; nearly all of us who are strong and vigorous and healthy love the rough mountains. We notice as we ascend that the distant hill-side looks beautifully green; like a velvet carpet is the grass. The leaves on the trees seem thoroughly beautiful; every bush seems to be perfectly made. As we look ahead of us, there, too, everything seems to have been spread as by the hand of God himself to cover every nook and crevice of the earth. The trees there seem to assume perfect shape. It is only where we are standing that the grass looks brown, that the earth shows up between the grass and the trees do not seem to be perfect in shape. It is a fact, gentlemen, that distance lends enchantment to the view, that that which is far behind, or that which is far ahead of us assumes magnificent proportions. So is it with the times through which we are passing. The early days seem to have been delightful; the time that is yet to be is painted by hope with glowing colors; but the days through which we pass are the days which are hard. It is today that is said to be undesirable. Yesterday appears to have been beautiful; tomorrow is yet to be glorious.

Just here, gentlemen, I protest against any such philosophy. Here tonight I shall endeavor to show you that today is the best day that has ever dawned in the history of the world; and the only day better than today may be tomorrow, but never yesterday. My contention is that no matter how glorious the heights man has reached, they are but foot hills compared with the heights of the conquests which mankind shall yet attain. My contention is that no matter how happy, no matter how prosperous, no matter how great a people has become up till today,—the future holds out possibilities of much greater greatness than that which has been achieved in the past history of mankind. For if it be true that the past is better than the present, that yesterday is better than today, I ask you to consider with me, for a few moments, when this better period occurred, politically, economically, socially, religiously. Were political conditions better in the time of the Greeks, when the Thirty Tyrants ruled the little Peloponnesus? Were conditions better in Rome, for example, when the Roman people had to rise in their might and drive the Tarquins out of Rome, or when Caesar, over night, was the means of converting the Roman Republic into an Empire, a Caesarism? Were conditions better during the period when Florence was in the grasp of the Medici family, or when Venice was dominated by the Doge, when the hole in the wall of the Council Chamber, known as "the Lion's Mouth," was the means of leading to the destruction of the best citizens of the commercial republic? Were political conditions better, for example, in the time when Ferdinand and Isabella ruled the territories of Spain? Were they better during the Middle Ages in any part of Europe than they are here in America? Or will you say that those were ideal times when that brute-beast, Catharine II., ruled the territory of that mighty empire of eastern Europe known today as Russia? Or, perhaps, it may be contended that political conditions were better when King George III. was the ruler of America, when, under the direction of Lord North, he permitted those conditions to arise which resulted in the separation of the United States from the mother country? You may admit, with such an array of political incidents referred to, and they can be increased indefinitely, that political conditions may be better today than they were once upon a time.

But, you say, social conditions were better in the past than they are today. Let us open the pages of the Bible and see whether in the time of Jeremiah, for example, conditions in Israel were better than they are now. Did not Jeremiah inveigh against the people saying, "Every man neighed after his neighbor's wife"? Were social conditions any better in Greece when the married woman was a slave without rights and the women admired in society were the hetairae? Were conditions better in Rome when the married woman was a chattel, having absolutely no rights in low, when she was a slave in the house of her master, who owned her? Or were social conditions any better during the Middle Ages? If you think they were, then I advise you to read Lecky's "History of European Morals"; or Henry C. Lea's "History of the Spanish Inquisition," and I think you will modify your opinion as to previous social conditions. It is perfectly true that the sun shone in those days brilliant and beautiful; it is perfectly true that the birds sang all through the summer; it is perfectly true there were plenty of good cakes and ale in the old sunny England of those days. But the man who will seriously contend that social conditions were better in previous ages than they are today is, in my judgment, a fit applicant for a room in a lunatic asylum.

Men urge that, economically speaking, things used to be better. It is perfectly true that we always had an element of poor people under old social conditions, and no economics has, as yet, been devised by the mind of man to overcome that natural condition to which Scripture referred, in the Old Testament, when it says, "the poor shall not cease out of the earth," and in the New Testament when it says, "the poor have ye with you always." But there is this one difference between the status of a poor man in former ages and that of a poor man today. Today the poor man is entitled to, and gets of right, the same rights as the richest man. He has a vote, as the richest man, and if he permits that one vote to count for less than the vote of the richest man it is because many deliver themselves over to the richest man, and the richest man knows that, all too frequently, he deals with a purchaseable quantity. The poor man today is a sovereign in his own right. He has rights in law that none can dare controvert without imperiling the institutions of free countries. Therefore, to compare the poor man of former times with the poor man of today, the working-man of former times with the working-man of today, is to introduce a comparison which of necessity must be a contradiction in terms.

When we deal with the question of religion shall we say that times were better, religiously, in former days than they are today? Now there are men who occupy pulpits who inveigh against the general air of irreligion especially in a country like America, who inveigh against the church's empty seats, who see mostly women in the congregation, and ask "Where are the men?" I have no doubt that when the pulpit of today will be brought up to a proper level the men will go to the church as well as the women. Conditions, however, religiously speaking, are better today, in my judgment, than they have ever been in the history of the world, if we understand religion properly. Certainly you can not call those better conditions when, in ancient times, men, called priests, built their temples to grinning idols and in the courts of those temples couches were placed upon which the virtue of women was sacrificed as an offering to the god they worshipped! Certainly you could not call those conditions of religion better when men worshipped in the open air, or by the side of the streams, or under the whispering trees, all those selfish and licentious deities of Olympus! Certainly you can not call those conditions of religion better when the state religion was such that the officiating minister, or haruspice, would, while offering the sacrifices, turn his head aside to wink at his fellow-minister, rejoicing at the deceit practiced in the full view of the Roman citizens, or when the destinies of the state were determined by the size or color of a pigeon's liver! Certainly you could not call those conditions of religion better when the world was at war for a hundred years at a time in the name of religion! Certainly you can not call those conditions of religion better when men took the sword into the church and laid the weapon of war upon the altar of God, invoking upon the bloody sword the blessings of a God of love! Certainly you cannot say that those ages were better than today!

Let me call your attention to a particular incident that occurred in this city today as an indication of our better understanding of the spirit of religion than that which has come down to us from the dark past, with all its bitterness and bigotry. This afternoon at three o'clock there was consecrated within a few miles of the city of Pittsburgh, at Wilmerding, a little home called the St. Barnabas Home, erected under the inspiration of a young Episcopal clergyman, whither are sent poor incurables of all creeds as inmates. The officiating clergymen there today were the Episcopal Bishop of Pittsburg, the Roman Catholic Bishop of Pittsburgh, and the Rabbi, the Jew, who is now speaking to you. Such an occasion, when Roman Catholic and Protestant and Jew can stand side by side and unite in the same work of love and charity, is an indication of a better understanding of religion than has ever come down to us out of the bleak, dark and dismal past. (Great applause.)

And now, gentlemen, I must hurry on to my argument, because I am afraid I have left it just hanging in the air. If then, in the past, conditions were not better than they have been, and if I have, I hope, sympathetically engaged your attention to a consideration of yesterday, may I not urge that, at this present moment, we are on the eve of the best period in the history of the world, as can be made manifest to you by a consideration of conditions existing universally today?

It has very often and very positively been asserted in the past that the limit has been reached, that we cannot go farther. I have no doubt that, in this very Club, the assertion has been made often that railway trains cannot go beyond a certain speed, and that you will never find an engine able to carry more than 5,000 tons, or something about that. Such statements have been made in every direction in the past; and not only have they been disproved, but that which has been accomplished is only the prelude to that greater work that shall yet be accomplished by mankind.

Let us take the science of medicine, for example. A couple of hundred years ago there was a very distinguished surgeon in France, whose name was Dr. Ambroise Paré. He performed an operation on the patella, or knee cap, removing it and replacing it, or something of that sort. And then he cried, "Eureka, the end has been reached; I have discovered the greatest thing in surgery." Gentlemen, I have been present in the amphitheatre of the Jefferson Medical College in Philadelphia, and I have seen Dr. W. W. Keen open a human head, take out a human brain, remove a tumor from it, put the brain back again, sew up the head, and say to his patient, arise and walk; and that patient did arise and walk. Forty years ago the greatest surgeon in the United States, Samuel Gross, one of two men to whom a national statue has been erected in Washington, wrote a book on Surgery. That book was only five years old when it was entirely out of date, because Gross had refused to recognize the growing conception of antiseptic treatment of wounds. Joseph Lister—and it is after him that Listerine has been named—at that time a young army surgeon in England, had discovered the principle of antisepsis and Gross is said to have laughed at it and regarded it as ridiculous. But within five years that man's great work on surgery was antiquated and a new era had opened up.

In 1836, about 70 years ago, the distance from the earth to the stars was not known. No human being knew how far it was from the earth to the stellar bodies. An eminent astronomer said in 1836 that the distance from the earth to the stars could never be known. It was within a year that the star No. 51 of the constellation Cygni was discovered and its distance measured. From that time to this by means of stellar photography and the spectroscope, we not only know the distance from the earth to these luminaries, but we know the composition of the stars and their weight; and men who understand astronomy mentally move among the stars of the heavens as familiarly as do you and I among the streets of Pittsburgh.

Then again, in the time of Lyell no man understood what a fossil was. One preacher said fossils were put in the earth by the will of God, who could do anything He pleased. Another preacher dismissed fossils by saying, "they were put into the earth just for the fun of it." You and I, who have been to school since then, know that fossils are the souvenirs of ages so far distant in the past as to make one stagger at a consideration of the millions of years they must have been in the earth.

It is only 40 years ago since the institution known as the Red Cross Society came into existence. Up to that time the wounded on the battle field were left to die and perish in the most brutal fashion. The Geneva Convention met in 1866 and a company of men and women throughout the world were humane enough to understand that the wounded enemy and the wounded friend were equally children of God and equally worthy of consideration. Today their spirit has grown into the broader internationalism which asks not the race of a man, nor the creed of a man, nor the country of a man, nor the color of a man, but seeks the good of man. That greater internationalism is growing and spreading all over the earth, and has now found expression in the Universal Peace Movement, to which I, for one, am pledged, and to which many good persons of this country are equally pledged, and concerning which I speak in season and out of season because I believe it is a prophesy of the better time that is coming when men will solve their international problems with exactly the same degree of common sense as they now solve their private problems. Powder and smoke and sword and blood and tremendous physical force never yet made a question right; and might, as might, never yet became the ultimate arbiter of questions involving moral principles. I can choke a babe very easily, but that does not make me right and the babe wrong. And so modern Germany, and modern Russia, and modern America, and modern Japan, even with the arms and sinews of war and an overflowing treasury, may go out into the world to solve a problem by the arbitrament of arms, but I tell you, gentlemen, that "he that draweth the sword shall perish by the sword," even as the Master of Christianity himself said. Moreover, I say to you that men are too precious, and young men are too full of hope and value to society, to be made the targets of shot and shell, and to solve problems by their death, when they should be solved by an appeal to reason. If there is any evidence needed that today stands for better things than yesterday, I lay before your consideration this international peace and arbitration movement that has made such splendid advance since 1815, when it was first started, and which, within the past ten years, has appealed to the conscience of humanity as perhaps no moral problem ever has within so short a time.

It is not otherwise in the matter of business. There are men who have very little conscience in the matter. They are like that poor fellow who called upon Andrew Carnegie some time ago and asked for help, and the valet of Mr. Carnegie said that the applicant could not see him. "You tell him God's brother-in-law is here, and he will see me. I am quite sure." Mr. Carnegie saw the man, helped him, because that is what he really wanted, and as he was leaving said to him, "Tell me how you came to say that you were a brother-in-law of God?" He replied, "My father-in-law had two daughters. I took one and God took the other."

This policy of subterfuge is not permitted in modern great business transactions, any more than the attitude of the deacon who was called upon to offer prayer. He said, "O Lord, I thank thee that I am not as other men, I thank thee that I am not a millionaire, I thank thee that I am not a monopolist; but I wish I was." Nor can an attitude toward human progress be taken, as in the case of the deacon of the church who called upon the pastor to offer the opening prayer. The pastor got up and offered a very eloquent prayer, telling the good Lord all about the news of the village, the kind of weather and the kind of sickness that was in the town, and other interesting wireless telegraph messages to God, and wound up by saying, "O Lord, I pray Thee, that Thou wilt keep me humble so that I do not deny Thee, and that Thou wilt keep me poor so that my spirit rise not up against Thee." And then the deacon arose to offer his prayer and among other things he sent certified messages to Heaven that all the brother pastor had said was perfectly true, and concluded by saying, "O Lord, especially, we ask Thee to hear the prayer of our brother, the pastor; and we do assure Thee, Lord, if Thou wilt keep the brother pastor humble, we will see that he is kept poor."

Business, commerce, is the great civilizer. Wherever commerce goes there must go the spirit of peace, integrity and sympathy. There is nothing which makes for international peace and honor so much as international commerce. And there is nothing that should make for amity and friendship and sympathetic consideration more than commerce. Your meeting here tonight is a manifestation of that very spirit; it is manifest that you men understand the great underlying principles of commerce. There was a time in the history of the world when men had their shops side by side and put outside those shops individuals to tell you that "Codlin was your friend, not Short. If you come into this store," they said, "you get better treatment than in the other store." They had their "barkers" outside, and they maligned their neighbors and "cracked up" their own store. There is no modern civilized man that would stand that form of business today for a second. And I believe that I interpret the soul of business properly when I say to you, who are business men and understand business as I do not, that you know that there is nothing that hurts the individual in the eyes of the purchaser more than the contemptible habit of speaking in terms of reproach of ones competitors. Business means mutual help. Business men like to get together in the same block. The growing spirit of emulation and competition, when it is conducted along proper lines, must become the source of a more splendid development of human sympathies.

Just one more illustration. When I was a lad I lived in England. I was born there. I am one of the ninth generation of an English family living in London. My father and grandfather and various grandfathers before me lived there. And I used to believe that we had a pretty decent government there in England, and I have no doubt we have. I believe municipal government has been made as nearly perfect, in that dear little island in which I first opened my eyes, as anywhere in this world. I tell you, gentlemen, while I greatly appreciate being an American citizen, while I endeavor on all occasions to do my full duty as an American citizen as I see my duty, while I regard as one of the proudest honors that have been conferred upon me, the glory of being an American citizen, there are some things that even we, in this great America, can learn from the old world, and municipal government is one of these. I do not know how you think of municipal government here in Pittsburgh; but, I think, it is barely possible that municipal government, even in this great city of Pittsburg, could be slightly improved. (Cheers and laughter.)

I was a boy who loved Queen Victoria. I fairly worshipped that woman. I always spoke with the greatest reverence of the Prince of Wales, and it required my removal from England to come over to this country to see that in my dear little wife I had the equal of Queen Victoria, and in my little girl I had an equal of her mother, a queen in my own household. I had to come to America to understand that woman here in her home is by right of birth a queen, and man in his manhood a sovereign of equal power, (when he uses his life in the right direction), with any crowned monarch that ever sat upon a throne. That is to me the meaning of America. It is not a country in which to develop only railways and railway products. It is not a country in which to boast about our tonnage and tonnage and tonnage, until we get blue in the face talking about our tonnage. There are other things in America besides tonnage. While I believe, gentlemen, that tonnage is a very important element in the economic development of a city, while I believe that if it were not for our tonnage in Pittsburgh, at least, I would not get the salary I am being paid, I can not help feeling, for the life of me, that there are matters which touch the American conscience and the American character, which are even of greater importance, than tonnage. Moreover, the American government is the hope of the world. Should this conception of government of the people, by the people and for the people, fail here in America, the entire history of mankind would be set back. This nation is a light set upon a hill, and the Statue of Liberty in the harbor at New York City is no idle fancy, is no mere poet's dream. It is the expression of the aspirations of a great people, who are called of God to impress upon all the nations of the earth that splendid ideal of liberty which was born in New England out of the contest with Great Britain, and which for over 130 years has been the invaluable inheritance of every son and daughter of America, the most precious inheritance that you and I can leave to our children. There are moral questions before this country today just as grave and just as important. I dare say, to you, more grave and more important than the mere question of tonnage and products and railroads and so on. This country is facing the great issue of the moral organization of business, the introduction of the Ten Commandments into the business world, and we who are a liberty-loving people, and we who, at heart, are a religion-loving people, and we who, at heart, are really an honest and sincere people individually, shall collectively make conscience to be felt and the spirit of honor to be manifested and the splendid spirit of integrity to be shown in our commerce, in the great financial undertakings of this great people.

I remember hearing a story on one occasion, even if it takes a few moments I must tell it to you, and even though some of you have heard it before, as an illustration of the point upon which I just touched, that, whereas in Europe, they still have the patent of nobility imposed, with a crown, upon the head of the chosen few, here in America we have placed it upon the head of manhood and womanhood. There was once a man who was very rich. He made a lot of money. He did not make manners at the same rate; he did not make culture at the same rate or to the same degree, but he made a lot of money. Becoming conscious of his weakness, he saw how bizarre and awkward and gauche he was in all his undertakings. So he thought it his duty to get some education, and he hired a teacher. He said to the teacher: "Teach me quick, teach me quick; I will pay you for it." During the first lesson he learned that this earth, upon which we live, is round. "What," he said, "the earth is round? What rot is this you are telling me?" "Yes, the earth is round." "How can that be when anybody can see that it is perfectly flat?" "There is no use in you asking me questions like that. I tell you, with the authority of the teacher, that it is round. The earth is round. I am the teacher and I tell you that." That was the end of the first lesson. The second day the teacher came and said to him: "Not only is the earth round, but the earth moves." "Oh," he said, "you do not believe that I am crazy enough to believe anything like that. I have been living on this corner for forty years. My house has never moved a particle. And you want me to believe that the earth is moving? How much do I owe you?" He settled with the teacher and dismissed him. Then he said to himself: "If I didn't know these things, I don't suppose anybody else knows them. I will give an entertainment for my friends and relatives and I will astonish them." So he had invitations sent to his friends and relatives, and gave a great dinner. He sat at one end of the table with his rich relations, and the teacher sat at the other end with the poor relations. After the banquet was over he got up and said: "My friends, I want to say to you that I realized that I was not a learned man and it was a shame to have as much money as I had and not be educated. So I have been studying and I want to share with you the information that I have gained. Now none of you know that the earth on which we live is round." There were expressions of great admiration from all around the table. "Wonderful man! Ain't he grand? No wonder he made a fortune." Then he said: "Not only that; not only is the earth round, but the earth moves." But no, they would not have that any more than he would. Several of them pointed to their forehead, indicating that he had taken leave of his senses. One went so far as to say, "Much money hath made him mad." When, seeing the look of unbelief on their faces, he turned to the teacher and said: "Teacher, you see my friends around the table will not believe that the earth moves. Will you please tell me if the earth moves or not." The teacher said, "I really don't know." "What," he said, "you don't know?" Didn't you teach me yourself that the earth moves?" He said, "I may have taught it to you, but I have changed my mind on that question." "What do you mean? You have changed your mind? Has a teacher a right to change his mind when he gives information on scientific questions?" "Well," he said, "when I came into the room tonight I believed that the earth moved, but I have changed my opinion." "Will you tell me why?" "Well," he said, "when I came into the room tonight the turkey and cranberry sauce and cake and champagne and cigars, were all up at your end of the table. Now, if the earth moves, don't you think it is time they came down to this end of the table?"

Yesterday, gentlemen, the good things of this earth belonged to the chosen few. Yesterday the champagne and the ice cream and the cigars and the cake belonged to the select, the privileged classes. Today, under the inspiration of the idea of liberty those great benefits to humanity which were the possession of the few, are offered to all men, and government, as we understand it in the United States, offers to the humblest man the same rights, the same opportunities, that have been offered to those who are now the chosen of the social and the economic world.

Yesterday and today. It seems to me that the balance of proof is in favor of today. But whatever we may believe of today, it stands as a dark shade compared with the greater good which belongs to you, gentlemen, and to all human society in the future.

Do I hear the croaker say, "No!" Do I hear him say, "Look at the conditions through which we are passing! Look at the depression! Look at the general lack of conscience! Look at the dishonesty and dishonor in high places! Look at those positions, where we have a right to believe we shall find integrity and fidelity, the positions of trust that have been disgraced by the dishonorable and degenerate action of men who have to guard the widows' funds and the orphans' future!" Quite true, I admit it; there are some bad men today. There have always been some bad men; there probably always will be some bad men. There have been plunderers in all ages; there has been graft in all ages; there has been trickery in all ages; there is some graft today, there will be some graft tomorrow. I am not one of those men who simply look at the sun and refuse to see the clouds on the horizon. I look squarely at the dark conditions. But modern life surely has its hopeful side and I am pleased to cast my ballot in favor of the optimistic outlook.

Many of you lived through the period immediately after the Civil war, and you know that during the Civil war there was graft. Ten years after the Civil war there was graft, and twenty years after the Civil war there was graft, and thirty years after the Civil war there was graft, and forty years after, and in the opening years of this century there was graft. Who cared for graft in the seventies? Who bothered about graft in the eighties? Who brought it to the attention of the public that their rights were being filched from them in the nineties? We have heard of it since 1901, and we have awakened to these circumstances and have recognized the evil of the conditions. And, when men realize wrong, and when they set themselves faithfully to overcome wrong and to uproot wrong, this does not mean that we are living in a worse age, but in a better age. For, only when man's conscience has been touched and awakened do you find conditions improved. I say to you tonight that if the American conscience has been quickened within the past seven years to a degree that it had not been quickened for forty years, or since the days of the Civil war; if men today are looking upon the moral side of the various issues by which we are confronted; if men today insist that the heads of great corporations must be first of all honest and honorable men, we owe this changed condition, we owe the recognition of the sins of the past, more to the splendid services of one man than perhaps to the whole eighty millions of people in the United States put together. And I tonight want to take this opportunity, even in a body of men associated with railroads, even in the Railway Club of Pittsburgh, to express my appreciation and my high regard and my great gratitude, that during the past seven years the destinies of this nation have been guided by that honorable, upright and fearless servant of the nation, Theodore Roosevelt. (Great applause.)

But, gentlemen, just a word about tomorrow. We have discussed yesterday and today, and I want to say with regard to tomorrow that I can do nothing better, in my judgment, at this moment, (and I have been speaking already for more than an hour), than to picture to you, in words, of course, to set before your minds for a consideration of the future, two pictures. One picture was painted by M. Fritel, the French artist, and one picture is painted, in words, by myself. I have described these pictures before various organizations here in Pittsburgh before, and I never fail to do it whenever I can when I come in contact with a new body of men. These two pictures are the embodiment of my idea of the past and the future.

Here is a picture called "Les Conquerants." If you look at the picture you will find the background is a very dull, heavy, dark gray. In the center of the picture is a spot of light; and in this spot of light there are six men on horse back, Sesostris, king of Egypt; Nebuchadnezzar, king of Babylon; at his side Alexander the Great, who conquered the earth and sighed for more worlds to conquer; at his side Julius Caesar, the greatest military leader of ancient times; Timour, a great scourge of Europe; and by his side the most remarkable military genius the old world ever produced, Napoleon Bonaparte. Heralds send before them the loud hosannas of victory. Flags are flying greeting them as they march down the stage of history, hailing the conquerors of men. But see, gentlemen, as this great cavalcade moves onward the horses' feet, the wheels of the cars, pass between lines of stiff and stark and naked dead bodies of human beings. The great conquerors of history, the military conquerors, have moved to their victories over the dead bodies of human flesh and blood.

See here, now, gentlemen, what follows. This picture is also called "The Conquerors." The background is a brilliant blue. In the center there is a body of men of whom the world has never been worthy. They have no gaily caparisoned horses. Theirs are not the golden cars. They have no heralds to proclaim loud hosannas of victory. They have no sword with which to smite, no shield to protect them. They are the despised and rejected of men. Here, in the center of this body stands the majestic figure of Moses, the great law giver and master in Israel. To his right stands Isaiah, the wondrous golden-mouthed orator of Jerusalem, and on his left side stands Isaiah, the silver-tongued orator of Babylon. Here again on the right stands Jeremiah, "the man of sorrows," of the Old Testament, and yonder, to the left, stands the man of visions, the wondrous Ezekiel. Gathered about this body of men may be seen twelve men, all looking to the hopeful future, the twelve Apostles of Righteousness, the twelve Minor Prophets. Higher up in the same picture may be found another group of the sons of Israel; higher up, not because they are more exalted, but because they came later in history. There in the center stands the majestic figure of the founder of Christianity, the Prophet of Nazareth, with hands outstretched to bless, and around him twelve men, his twelve Apostles, men whose spirit, with that of their older brethren, has conquered the world. These men were, as I said, rejected and despised. Upon them was placed the burden of humanity. They were crucified, hung over slow fires, and cast into pits to starve to death. The dens of lions were for them, the hatred of mankind was their reward. Hooted at and spat upon, were they. Wherever they went they were denied, despised and derided. Theirs was the shield of justice, and the sword of truth, and the breastplate of righteousness. On their feet were the humble sandals; in their hands the shepherd's staff. They wandered from nation to nation teaching a God of love and of righteousness. Conquered in their day, and beaten, were they. Yet I say to you, in spite of the progress we have made in passing from yesterday to today, that these men, on this side, represent the brute force of the world and the conquests made by physical might in despite of right; yes, these men, on this side, will yet be called brutes, assassins, murderers. While these men, on yonder side, because of the spirit they manifest, will tomorrow be heralded as the true conquerers of humanity. (Prolonged applause.)

MR. F. H. STARK: Mr. President, guests and fellow-members of the Railway Club of Pittsburgh:

In behalf of the Club I desire to extend our appreciation for the very instructive and entertaining program rendered. Indeed we are to be congratulated for having as special guests persons of such extraordinary ability.

Dr. Levy is justly recognized as the foremost orator of Western Pennsylvania, a man of national reputation, a scholar of rare attainments who, through study and extensive travel, has the knowledge of nations and peoples possessed by few. His life work is for the betterment of mankind as exemplified by his masterly address here tonight.

Messrs. Johns, Mees and Curry have delighted us with their exquisite music, sustaining their established reputation as musicians. I am especially proud for they are neighbors and personal friends of mine.

Mr. R. P. Forsberg very vividly portrayed in his interesting manner the experience of home life. Mr. E. C. Adams rightly belongs to a class by himself. He is as clever as he is delusive. We should feel grateful to him for the marked consideration granted us when you recall the advantage he had over the most of us at least.

I have been a member of this Club for over six years and we have never enjoyed a program of such excellent order as we have enjoyed tonight. I move that a vote of thanks be extended to all who have contributed to this most successful occasion.

Motion carried unanimously.

Adjournment.

# Minutes of Annual Meeting Society of Railway Club Secretaries, Atlantic City, N. J., 1908.

The annual meeting of the Society of Railway Club Secretaries was held at the Hotel Brighton, Atlantic City, N. J., on Saturday, June 20th, 1908. The various Clubs were represented as follows:

NEW YORK RAILROAD CLUB—Mr. Harry D. Vought, Mr. Daniel M. Brady.

CENTRAL RAILWAY CLUB—Mr. Harry D. Vought.

NEW ENGLAND RAILROAD CLUB—Mr. George H. Frazier.

ST. LOUIS RAILWAY CLUB—Mr. B. W. Frauenthal.

RAILWAY CLUB OF PITTSBURGH—Mr. J. D. Conway.

CANADIAN RAILWAY CLUB—Mr. James Powell.

In calling the meeting to order, Mr. Powell, Chairman of the Society, expressed his pleasure in once more greeting his fellow members and that the representation was better than he had ever known. Mr. Powll regretted, however, the absence of any representation from the Western Railroad Club.

The Minutes of the semi-annual meeting were read and approved.

The Secretary-Treasurer presented the following annual report and financial statement:

## Secretary-Treasurer's Annual Statement.

Your Secretary-Treasurer at this annual meeting has no new message of importance to convey, no unusual suggestions to offer and no particular criticism in mind for your consideration.

Our Society has steadily pursued the even tenor of its way during the year. Whatever measure of benefit may have resulted from an interchange of thought and opinion in the past has been manifest in such progressive work as the individual organizations we represent have done. Whatever they have accomplished in the line of usefulness and enlightenment that they are expected to achieve may be said to have found some inspiration in the thoughtful devotion of their secretaries in meeting the exactions their duties and responsibilities impose. In some degree and, possibly, more than ordinarily so, the growth and development of a railroad club depends upon how its secretary measures up to the requirements of his position. While, perhaps, much depends upon other officers and the members, it seems to be the rule and policy that the matter of initiative largely rests with the secretary. Therefore, his opportunity is ample, practically no serious limit restricts earnest effort. By judiciously applying his energies and ideas in a tactful way he can often imbue those higher in authority with some of his own vital spirit, persuading them, perhaps, to take advantage of a situation or create one that will redound to the credit of the organization. This has been known, in some instances, to be the salvation of a club that seemed to be threatened with disaster, giving it new stimulus and restoring diminished power and capacity. This is something upon which much more might be said by way of emphasis, but it is so obvious that it need not be dwelt upon.

Unfortunately, circumstances have prevented completion of the work undertaken in the direction of standardizing blank forms. Not the least of these has been the absolute failure in some instances to give the slightest heed to requests for copies of forms in use. Such as have been received are here for examination and it may be that the question can be more satisfactorily settled by the Society at this time than through a special committee.

The total receipts of the year, with an unexpended balance from 1907, were $229.53, and the disbursements were $224 50, leaving a balance on hand of $5.03. The chief items of expenditure were $115 for our annual dinner, and $88.25 for printing the Index of Subjects. Respectfully submitted,

HARRY D. VOUGHT,
Secretary-Treasurer.

On motion of Mr. Frauenthal, seconded by Mr. Frazier, the report was approved and the thanks of the Society extended to Mr. Vought for the able manner in which it was presented.

The attention of the Society was called by Mr. Frauenthal to the new regulation of the postal laws which prohibits the mailing of second-class matter of publications to subscribers who are six months in arrears.

The Secretary-Treasurer reported that he had extended an invitation to the Northern Railway Club of Duluth to unite with the Society, but had had no reply from its Firse Vice-President, to whom this invitation was sent.

The Secretary-Treasurer read a number of letters from gentlemen who were invited to be present at the annual dinner, offering their regrets at not being able to be in attendance.

The subject of standardizing blank forms for the use of the various Clubs occupied the attention of the Society for several hours.

A set of blanks was agreed upon and ordered submitted to the several Clubs with recommendation for their adoption by all.

The annual assessment upon the different Clubs for the current expenses of the Society was fixed at $10.00.

The publication of the Index of Subjects was ordered continued and an appropriation of $10.00 was made for the services of a Stenographer for the Secretary-Treasurer.

Election of officers for the ensuing year resulted as follows: Chairman, James Powell; Vice-Chairman, B. W. Frauenthal; Secretary-Treasurer, Harry D. Vought.

The Society then took a recess for luncheon as the guests of Mr. Brady.

## The Annual Dinner.

The annual dinner was served in the garden of the Windsor Hotel at 7:30 P. M.

The Society had as its guests Messrs. George W. West, Eugene Chamberlin, George A. Post, Sr., E. L. Janes, R. F. McKenna, Hugh M. Wilson, E. A. Simmons, F. H. Stark, Charles Waughwop and S. O. Dunn.

Mr. Frauenthal read the following paper:

In writing on the "Law of Compensation and Its Path," Emerson said: "Happy beyond my expectation, if I shall truly draw the smallest arc of this circle." With most of us thinking that the Sage of Concord not only drew the arc but completed the circle with geometrical precision, a circle of sufficient magnitude to touch all forms of human activity and within whose confines is to be found the essence of the result of all forms of endeavor whenever and wherever applied, my remarks shall chiefly be confined to the advantages to be derived from an appreciation of the principles of this law and the beneficial effect of their application in material as well as moral affairs. I become more deeply impressed with the truths enunciated by the philosophic Emerson as the years pass, and, particularly, does it appeal to me as being desirable at this time of general unrest and antagonism towards railroads displayed in so many quarters, that they be borne in mind by the servants of the public as well as by those having charge of the tremendous interests involved in transportation.

It is a beautiful and impressive thought that for each thing given something shall be received and no less that for each thing received something must be rendered. No one, no thing, be it the creation of man or nature, can escape this inexorable law. Corporations, individuals, society, things animate and inanimate, must bow to its inevitable sway and yield in return something in exchange for that which they receive; for life, protection, law, order, is a barter and exchange and exact a fee that cannot be denied.

Recent years have witnessed the formation of giant combinations of capital and to the extent that they have preyed on commerce and labor they have been opposed by legislation and labor organized to enforce demands, the justice of which it shall not be my purpose to discuss; and to the extent that legislation or the demands of labor have been based on an arbitrary use of the power at the disposal of their directing agents without regard to the justice of their acts, to that extent has the respect accorded them and through which their strength was derived been sapped, and the very demonstration of power becomes a source of weakness. Are prohibitive legislative restrictions imposed upon the manufacture and sale of an article by levying an unreasonable tax, the purpose of deriving revenue through such channels are defeated by the curtailed production of the article taxed? Does the manufacturer or dealer seek recompense through inflated prices, the public refuses to buy and diminished sales reduce to its former level the average revenue engaged in the particular branch of commerce affected? Does the workman demand too much for his hire, the needs that call forth his presence are restricted and where this cannot be done, compensation is exacted from him through the avenues by which he is compelled to barter the result of his labors, and turn which way we will there is ever before us the sign manual of that law which says in effect if you want a thing pay for it and take it; for all things have a price, and truly has it been said that unless you pay the price it is not the thing you receive, but a base substitute.

And if this be true, how important it is that the individual should make of it a source of strength rather than weakness, by harmonizing his actions with this eternal principle, instead of vainly endeavoring to evade its irresistible adjudication of all things in the end.

As the family is the unit of the nation and the purity of the home marks the strength of the whole, so is the individual employe of every business concern and corporation the unit of which the wonderful organizations of today are constructed, and their honesty, integrity and loyalty the foundation of such success as they may attain. Never in the history of commerce, which is the history of man, has the need of a full understanding of this fact been so great.

Apostles of discontent preach the limitations placed by existing conditions on individual endeavor, yet never was there a field so rich in possibilities as that of the present. Particularly is this true of that portion of industrial life in which we are engaged, transportation and its associated activities. Its highly specialized departments demand highly specialized men at their head, and opportunity with its glorious golden vista, instead of knocking at the door but once, lies waiting at the feet of he who perseveres and to richly compensate him for his energy.

In this sphere, pre-eminently, are to be found innumerable examples of the immutable law of compensation, and to have place, power, office and emolument, you have only to put their equivalent, work, study, application and sound judgment, into the company in exchange. And just to the extent that this is done do you become an integral part of its corporate being. The parasite who merely renders sufficient service to meet the requirements of efficiency is compensated by remaining in the ranks, and by dwarfing his mental stature to the extent he has refrained from exerting his abilities. Much has been said on the need, the advantages and the beneficial result of co-operation in railroad work. Co-operation is only a change in form, but not in substances, of compensation. Does the departmental head, while keenly seeking to maintain the highest possible state of efficiency with the expenditure of only such an amount as will in justice make this possible, bear in mind that other departments are being conducted on similar lines and that mutual advantages can be reaped by co-operation under certain conditions, and set the example for his assistants and employes, the entire staff follows in his wake and the work of the department, as well as the result for the company, shows that compensation is the co-ordinate of co-operation. The official willing to assist his co-worker, who guides others over treacherous paths that are known to him through the wisdom of experience, reaps a rich reward by the affection in which he is held by rank and file.

And equally true is the reverse. The head of the department seeking to evade responsibility, to reduce expense at the expense of another department, who criticises and destroys, reaps the reward of aversion and indifference on the part of his fellow-employes and impairs his worth to such an extent that the law of compensation forces his retirement sooner or later. And if there be such need of a recognition of this law in the conduct of the internal affairs of a great transportation property, the need of it by those of its agents and employes coming in contact with the public are a thousandfold greater.

Is the agent rough and uncouth in manner and speech his assistants cannot be expected to be different, and does one of them conduct himself in a surly, indifferent manner toward a patron, straightway is the company compensated by the loss of that patron's business and the employe by a reduction of his value to the company and the contempt of the patron. No one has reaped any gain or profit; but, on the contrary, the germs of lasting antagonism have been planted in a field fertilized by the operation of this ever present law. But let the agent set the example of pleasant speech, cordial and intelligent interest in the patron's welfare, which is identical with that of the company, and the compensation is sure and profitable to the company and to himself; for the company will be assured of increased business through the friendship of the patron and the agent through the channels of personal consideration and regard such conduct is sure to command, and the further pleasing sense of duty well done. The patron will feel that nothing which will promote his safety and welfare, contribute to his comfort, and put him in possession of legitimate knowledge covering matters which may be of value to him in the guidance of his business affairs, will be neglected or will be considered anything but as a pleasure the company, through its agent, feels in extending, and the harmonious relations thus established can be nothing but mutually profitable.

Everywhere we turn and in every relation is found the effect of this unchangeable law. From it there is no escape, nor does the intelligent seek to claim advantage, privilege or preferment without the expectation of feeling its force. No honest act or transaction but has its recompense in the being of he who participates in it. No dishonest one that does not exact its return in the same manner. Right thinking, right conduct and right living bring their sure reward. Nothing can detract from the serenity of mind and tranquility of soul of he who walks upright along the path of this law. Reverses, misfortune, are but an incident in the development of latent qualities that are awaiting such shocks to be galvanized into life, and the effect is to strengthen the character and render more resolute and indomitable the purposes of his will. The disapproval of his superior officers of some cherished plan or innovation will not leave him with feelings of resentment rankling within him to canker his confidence and respect for their ability or purposes. He is compensated, should his suggestions be adopted, by the credit he received for them, and, if disapproved, by the knowledge that the fact of having originated them conclusively shows the possession of ability and a discontent with the established order of things that presages further and greater development in the future. Nothing is without purpose or end, shrouded in mystery though it may be. One failure will not discourage the man of stamina and purpose, but will spur him to greater effort and with each rebuff will he gather strength to continue and realize later that it is no idle proverb that "All things come to him who waits," provided he couples his patience with honest endeavor and singleness of purpose.

The gospel of truth, the golden rule, consideration and high ideals must be preached by every man in a position of authority over and over again, his life must be a daily sermon and his every act a benediction; for emulation of his conduct, both private and official, is sure to be found among his subordinates and the truth of the adage, "Like master, like man," demonstrated. The knowledge of the courteous reception awaiting them has emblodened many employes to offer suggestions that have proven of inestimable benefit to the service. Petty tyrannies, snobbish aloofness by the officials and a tendency to regard the subordinate employes as of no more consequence than a piece of mechanism that can be replaced when worn out have been the cause of inciting feelings of resentment that have cost the railroads hundreds of thousands of dollars in the careless and indifferent performance of their work by those occupying such positions and by the loss of labor that follows every opportunity to shirk. The loyalty of employes in commercial life has time and again been shown to have had its origin in the kind consideration of the employer of the employe's welfare and their ability to go to him for an adjustment of their troubles with the confidence of fair dealing that their knowledge of his character and daily life has placed in their hands. How frequently has it occurred that expressions of resentment have been heard concerning the head of a department or his assistants by the employes therein, and how absurd is it to expect even a reasonable degree of efficiency where this spirit prevails. Something is being compensated for when this obtains, and the wise manager who cannot long be kept in ignorance of such a condition is less long in seeking the cause and applying the remedy. The same interest that the commercial employer displays in his men must be evinced by the railroads in order to obtain like results. Men are not machines. They are not devoid of sensibility, no matter what rough and uncouth exterior they may present. Their ideas will of necessity be different in many respects, for their point of view is seldom similar; yet there are none to whom the extension of that consideration which tacitly recognizes in each a human entity, and accords it recognition as such, that are calloused and hardened to such an extent that they cannot be found on the common ground of respect such actions invariably establish. It is the official who can grasp this truth and feel a heartfelt pleasure in applying it that is regarded as a welcome visitor by everyone fortunate enough to come under his jurisdiction. He it is, when calling for extra effort under emergencies, has the united support of every man in the department. He is the man whom everyone regrets to lose when certain promotion and advancement come, either in his own or other fields. He is the recipient of engrossed resolutions from his men in all branches of the service testifying to his unwavering justice, kindness and the consideration that caused the erring to be corrected with the minimum amount of punishment with the maximum amount of good. And it is he, by reason of the marvelous organization with which he is able to surround himself, that shows results unknown and only hoped for by the owners and managers of large properties prior ot his advent. Is it not worth the effort to perpetuate your memory among the employes, as has been conspicuously done in so many cases, that when the sphere of your activity has been transferred, the mere mention of your name conjures some act of kindness to the memory of those left behind and causes renewed expressions of affection and esteem to rise from the heart of the many who have benefitted thereby? Surely this is compensation enough for the effort to conquer the inclination to express disapproval and rebuke in terms of harshness when a mistake of judgment or execution has thrown affairs into a tangle that will require tact and ability to correct.

Nowhere can there be found a better or more shining illustration of the truth of the foregoing remarks than in the growth and development of those societies and organizations which it is our happy privilege to represent on this occasion. The first Railway Club was much in the nature of an experiment. There were no well established precedents upon which to model its lines. The spirit of rivalry was rampant. The domestic relations of the various departmental heads were often strained and their efforts to wrest control of the business of entire communities and territories whose traffic was yet undeveloped were often productive of bitter and acrimonious controversies that found an echo in their personal relations. By the formation of a society devoted to no special interest of railroad activity, but broad enough in its scope and purposes to include all, by opening its doors for the admission of representatives of every branch and promoting widespread discussion of problems confronting them, it was hoped to minimize the friction that was but a natural consequence of the existing conditions; to bring the members into a closer and more cordial personal relation; to remove impressions, generally erroneous, founded upon the struggle for superiority and to improve both the business and social relations of those constituting its membership. How well this virgin field of effort has compensated those pioneers who blazed the trail for us to follow, this gathering of the Secretaries of the Railway Clubs of America can best attest. For every doubt of the success of their plans, compensation has been given them in the realization of their full fruition. For every rebuff that befell them in their gigantic task of harmonizing the differences arising from conflicting interests they have been compensated by the pleasure incident to the knowledge that while the same earnest effort continues to be made by everyone to place the interests with which they are associated in the very vanguard of progress, it is accompanied by a healthy recognition of the purposes and intentions of others striving to attain a similar result and the production of that human sympathy, without which the utmost pinnacle of success is but the ashes of an ambition and represents nothing of its living grace and fire.

The worth of Railway Clubs to the railroad employe is scarcely less than to the roads themselves. Improved handling of transportation, accounts, everything concerned in these vast enterprises have profited by them. Their value can only be estimated but never denied. There is, then, much reason to feel that to be associated with such organizations is of itself a matter deserving of congratulation, but to have the honor of representing one of its branches in a convention of its Secretaries, to whom the active conduct of the Club's affairs is so often delegated, confers a sense of the trust imposed upon you and the regard in which you are held by your fellow-men that can well be felt by those fortunate enough to experience it but which my halting pen can form but poor phrases to express. For their confidence and esteem you are and will ever be a living compensation in the earnestness of your purposes and activities, and in the pursuit of everything that is conducive to the welfare of the interests intrusted to your care.

Here, then, is to be found the key of that success which is the natural hope of attainment of all—the Biblical dictum that "As ye sow, so shall ye reap"—compensation. Success first measured by an unshaken confidence in self-integrity, in a preservation of personal honor and the ability to look forward fearlessly with the calm knowledge that you are the ultimate master of your own destiny. Success founded on your knowledge that the world is better for your having occupied a place in the conduct of its affairs. Success in the knowledge that you have accomplished some part of its work in a way to meet the approval of your fellow-man, and the ability it has conferred upon you to lighten the burden and protect somewhat from the vicissitudes of life those whom fortune has exacted from you as hostages and those whom it has been your glory to love, honor and cherish, parents, wife and children.

Greater reward than this no man may hope to achieve.

I thank you, gentlemen.

Following remarks by Messrs. Post, Chamberlin and Brady and a brief season of social enjoyment, the dinner was brought to a close.

The Society was reconvened for a final session, and it was agreed that the matter of a semi-annual meeting be left to the discretion of the Chairman and the Secretary-Treasurer, and, if called, that it be held in Chicago on the fourth Saturday in January.

The selection of an orator for the next annual meeting, it was further agreed, should be left to the Chairman and the Secretary-Treasurer, in the event of a semi-annual session not being called.

On motion of Mr. Frauenthal, it was recommended that the subjects considered at Club meetings be scheduled on the front cover page of printed Proceedings.

On motion of Mr. Frazier, a vote of thanks was extended to Mr. Frauenthal for the thoughtful paper he had prepared for the dinner and which had met with so much appreciation and commendation.

A further vote of thanks was extended, on motion of Mr. Frauenthal, to Mr. Brady for the courtesies he had extended to members of the Society.

The Secretary-Treasurer was instructed to provide Messrs. Frauenthal and Frazier with an official badge of the Society as soon as circumstances would permit.

There being no further business, the Society adjourned.

Respectfully submitted,

HARRY D. VOUGHT,
*Secretary-Treasurer.*

# Railway Club of Pittsburgh Constitution.

## ARTICLE I.

The name of this organization shall be "The Railway Club of Pittsburgh."

## ARTICLE II.

### OBJECTS.

The objects of this Club shall be mutual intercourse for the acquirement of knowledge, by reports and discussion, for the improvement of railway operation, construction, maintenance and equipment, and to bring into closer relationship men employed in railway work and kindred interests.

## ARTICLE III.

### MEMBERSHIP.

Section 1. The membership of this Club shall consist of persons interested in any department of railway service or kindred interests, or persons recommended by the Executive Committee upon the payment of the annual dues for the current year.

Sec. 2. Persons may become honorary members of this Club by a unanimous vote of all members present at any of its regular meetings, and shall be entitled to all the privileges of membership and not be subject to the payment of dues or assessments.

## ARTICLE IV.

### OFFICERS.

The officers of this Club shall consist of a President, First Vice President, Second Vice President, Secretary, Treasurer, Finance Committee consisting of three members, Membership Committee consisting of five members, and three Elective Executive Members who shall serve a term of one year from the date of their election unless a vacancy occurs, in which case a successor shall be elected to fill the unexpired term.

## ARTICLE V.

### DUTIES OF OFFICERS.

Sec. 1. The President will preside at all regular or special meetings of the Club and perform all duties pertaining to a presiding officer; also serve as a member of the Executive Committee.

Sec. 2. The First Vice President, in the absence of the President, will perform all the duties of that officer; the Second Vice President, in the absence of the President and First Vice President, will perform the duties of the presiding officer. The First and Second Vice Presidents shall also serve as members of the Executive Committee.

Sec. 3. The Secretary will attend all meetings of the Club or Executive Committee, keep full minutes of their proceedings, preserve the records and documents of the Club, accept and turn over all moneys received to the Treasurer at least once a month, draw cheques for all bills presented when approved by a majority of the Executive Committee present at any meetings of the Club, or Executive Committee meeting. He shall have charge of the publication of the Club Proceedings and perform other routine work pertaining to the business affairs of the Club under the direction of the Executive Committee.

Sec. 4. The Treasurer shall receipt for all moneys received from the Secretary and deposit the same in the name of the Club within thirty days in a bank approved by the Executive Committee. All disbursements of the funds of the Club shall be by cheque signed by the Secretary and Treasurer.

Sec. 5. The Executive Committee will exercise a general supervision over the affairs of the Club and authorize all expenditures of its funds. The elective members of this Committee shall also perform the duties of an auditing committee to audit the accounts of the Club at the close of a term or at any time necessary to do so.

Sec. 6. The Finance Committee will have general supervision over the finances of the Club, and perform such duties as may be assigned them by the President or First and Second Vice Presidents.

Sec. 7. The Membership Committee will perform such duties as may be assigned them by the President or First and Second Vice Presidents, and such other duties as may be proper for such a committee.

## Article VI.

### ELECTION OF OFFICERS.

Sec. 1. The officers shall be elected at the regular annual meeting as follows, except as otherwise provided for:

Sec. 2. Written forms will be mailed to all the members of the Club, not less than twenty days previous to the annual meeting, by the three elective members of the Executive Committee. These forms shall provide a method, so that each member may express his choice for the several offices to be filled.

Sec. 3. The three elective members of the Executive Committee will present to the President the names of the members receiving the highest number of votes for each office, together with the number of votes received.

Sec. 4. The President will announce the result of the ballot and declare the election.

Sec. 5. Should two or more members receive the same number of votes, it shall be decided by a vote of the members present, by ballot.

## Article VII.

### AMENDMENTS.

Amendments may be made to this Constitution by written request of ten members, presented at a regular meeting and decided by a two-thirds vote of the members present at the next regular meeting.

# By-Laws.

## ARTICLE I.

### MEETINGS.

Section 1. The regular meetings of the Club shall be held at Pittsburgh, Pa., on the fourth Friday of each month, except June, July and August, at 8:00 o'clock P. M.

Sec. 2. The annual meeting shall be held on the fourth Friday of October each year.

Sec. 3. The President may, at such times as he deems expedient, or upon hequest of a quorum, call special meetings.

## ARTICLE II.

### QUORUM.

At any regular or special meeting nine members shall constitute a quorum.

## ARTICLE III.

### DUES.

Sec. 1. The dues of members shall be $2.00 per annum, $1.00 of same to apply to subscription for Club Journal, payable in advance, on or before the fourth Friday of September each year.

Sec. 2. Each member will be assessed $1.00 extra annually to provide light refreshments for each meeting.

Sec. 3. At the annual meeting members whose dues are unpaid shall be dropped from the roll after due notice mailed them at least thirty days previous.

Sec. 4. Members suspended for non-payment of dues shall not be reinstated until all arrearages have been paid.

## ARTICLE IV.

### ORDER OF BUSINESS.

1—Roll call.
2—Reading of the minutes.
3—Announcements of new members.
4—Reports of Committees.
5—Communications, notices, etc.
6—Unfinished business.
7—New business.
8—Recess.
9—Discussion of subjects presented at previous meeting.
10—Appointments of committees.
11—Election of officers.
12—Announcements.
13—Financial reports or statements.
14—Adjournment.

## ARTICLE V.

### SUBJECTS—PUBLICATIONS.

Sec. 1. The Executive Committee will provide the papers or matter for discussion at each regular meeting.

Sec. 2. The proceedings or such portion as the Executive Committee may approve shall be published (standard size, 6x9 inches), and mailed to the members of the Club or other similar clubs with which exchange is made.

## ARTICLE VI.

The stenographic report of the meetings will be confined to resolutions, motions and discussions of paper unless otherwise directed by the presiding officer.

## ARTICLE VII.

### AMENDMENTS.

These By-Laws may be amended by written request of ten members, presented at a regular meeting, and a two-thirds vote of the members present at the next meeting.

# MEMBERS.

Ackenheil, J. D.,
Rep. Patterson-Sargent Co.,
Linden Apartments,
Bates St.,
Pittsburgh, Pa.

Alexander, J. R.,
Gen'l R. F. of E.,
Pennsylvania R. R. Co.,
Altoona, Pa.

Alleman, C. W.,
Clerk, M. P. Dept.,
P. & L. E. R. R. Co.,
Pittsburgh, Pa.

Allen, Harry L.,
Manager,
American Steel Foundries,
Alliance, Ohio.

Allen, Harvey A.,
care Pressed Steel Car Co.,
McKees Rocks, Pa.

Allen, Jas. P.,
Sales Agent,
Union Steel Castings Co.,
61st St. and A. V. Ry.,
Pittsburgh, Pa.

Anderson, H. H.,
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Schoen Steel Wheel Co.,
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Anderson, J. B.,
C. C. to S. M. P., P. R. R. Co.,
Union Station,
Pittsburgh, Pa.

Anderson, H. T.,
Chief Draftsman,
Standard Steel Car Co.,
Frick Building,
Pittsburgh, Pa.

Armstrong, R. S.,
Mgr., West Disinfecting Co.,
16th St. and Penn Ave.,
Pittsburgh, Pa.

Arensburg, F. L.,
Rep., Vulcan Crucible
Steel Company,
Oakmont, Pa.

Atterbury, W. W.,
General Manager,
Pennsylvania R. R. Co.,
Philadelphia, Pa.

Atwood, J. A.,
Chief Engineer,
P. & L. E. R. R. Co.,
General Office,
Pittsburgh, Pa.

Atwell, J. L.,
Mgr., Philip-Carey Mfg. Co.,
333 Second Ave.,
Pittsburgh, Pa.

Ault, Chas. B.,
Sales Manager,
Lawrenceville Bronze Co.,
Pittsburgh, Pa.

Ayers, H. B.,
care, H. K. Porter Co.,
Pittsburgh, Pa.

Bagnell, R. A.,
Mgr. R. R. Dept.,
Invisable Roll Screen Co.,
No. 2 Wall St.,
New Brighton, N. Y.

Bailey, Robert J.,
Car Accountant,
Monongahela River Cons.
Coal and Coke Co.,
8 Market St.,
Pittsburgh, Pa.

Baird, F. C.,
G. F. A., B. & L. E. R. R.,
Frick Building,
Pittsburgh, Pa.

Baker, Edwin H.,
Rep., Galena Signal Oil Co.,
26 Broadway,
New York, N. Y.

Baker, J. H.,
Clerk, M. P. Pept.,
Union Station,
Pittsburgh, Pa.

Baker, Jas. H.,
1240 Palo Alto St.,
N. S., Pittsburgh, Pa.

Baldwin, Stephen Y.,
Com. Frt. Agent,
D. & H. Co., Bessemer Bldg.,
Pittsburgh, Pa.
Ball, Geo. L.,
Ball Chemical Co.,
153 Ohio St.,
Allegheny, Pa.

Barney, A. E.,
Alstead, N. H.

Barney, H. E.,
Rep., Manning, Maxwell
& Moore,
Park Building,
Pittsburgh, Pa.

Barnsley, Geo. T.,
County Road Engineer,
Pittsburgh, Pa.

Barron, John,
V. P., Versailles Ry. Signal Co.,
Columbia Bank Bldg.,
Pittsburgh, Pa.

Bartley, Milton,
President, American Nut &
Bolt Fastener Co.,
P. O. Box 996,
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Barwis, J. Mc.,
Fore. Insp'r., P. R. R. Co.,
Union Station,
Pittsburgh, Pa.

Basford, G. M.,
care American Loco. Co.,
Cortlandt Building,
30 Church St.,
New York, N. Y.

Bateman, Paul,
Car Estimator,
Pressed Steel Car Co.,
57 Bryant Ave.,
Bellevue, Pa.

Bealor, B. G.,
Mgr., Winfield R. R. Co.,
421 Wood St.,
Pittsburgh, Pa.

Beatty, E. G.,
Rep., Galena Signal Oil Co.,
Franklin, Pa.

Becht, Harry K.,
Supt. Transportation,
Carnegie Steel Co.,
Donora, Pa.

Bell, T. H.,
M. M., N. Y. & C.
Gas Coal Co.,
Turtle Creek, Pa.

Bellows, A. B.,
Manager, Pittsburgh
Testing Laboratory,
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Belsterling, C. S.,
Traffic Manager,
American Bridge Co.,
Frick Building,
Pittsburgh, Pa.

Benner, Jacob W.,
C. E., Steam Power,
Carnegie Steel Co.,
Munhall, Pa.

Benner, Samuel A.,
Gen'l. Mgr. Sales,
Carnegie Steel Co.,
Carnegie Bldg.,
Pittsburgh, Pa.

Bigelow, Harry T.,
Rep., Hale & Kilburn Mfg. Co.,
Fisher Building,
Chicago, Ill.

Bigham, Chas. G.,
Pass. Cond'r.,
P. C. C. & St. L. Ry.,
Room 107 Union Station,
Pittsburgh, Pa.

Bihler, L. C.,
Traffic Manager,
Carnegie Steel Co.,
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Birney, E. H.,
Sup't. Rolling Mills,
J. & L. Steel Co.,
1639 Denniston Ave.,
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Bixler, H. C.,
Ass't. Train Master,
P. R. R. Co., 15th St.,
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Blackall, Robt. H.,
355 Locust St.,
Swissvale, Pa.

Blattner, Jos.,
Cor. Allegheny Ave. and
Rebecca St.,
Allegheny, Pa.

Blest, M. C.,
Chief Draftsman,
Pressed Steel Car Co.,
17 Woodlawn Ave.,
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Bole, Robt. A.,
Manager, Manning, Maxwell
& Moore,
Park Building,
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Bolenius, H. C.,
Supervisor, Allegheny
Valley Railway,
Verona, Pa.

Booth, Arthur,
Asst. to Pur. Agent,
Philadelphia Co.,
435 Sixth Ave.,
Pittsburgh, Pa.

Booth, J. K.,
Genl. Fore., B. & L. E. R. R.,
Greenville, Pa.

Booth, Jas.,
Rep., Midvale Steel Co.,
Frick Building,
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Bostwick, W. A.,
Metallurgical Engineer,
Carnegie Steel Co.,
Pittsburgh, Pa.

Bowers, K. J.,
Mgr. of Sales, Acme White
Lead & Color Co.,
Detroit, Mich.

Bowery, Fred,
Vice Pres., American Nut &
Bolt Fastener Co.,
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Boyd, Henry W.,
Rep. W. Va. Fire Clay
Mfg. Co.,
1700 Buena Vista St.,
N. S., Pittsburgh, Pa.

Brady, Daniel M.,
President, Brady Brass Co.,
95 Liberty Street,
New York, N. Y.

Brand, Thos.,
Train Master,
Montour R. R. Co.,
Coraopolis, Pa.

Branson, Craig R.,
M. P. Inspector,
Pennsylvania Co.,
302 West Berry St.,
Fort Wayne, Ind.

Brayton, Chas. A.,
President,
Standard Car Wheel Co.,
Cleveland, Ohio.

Brentzel, J. E.,
Dispatcher,
Montour R. R. Co.,
Coraopolis, Pa.

Brewster, Morris B.,
Rep., U. S. Metallic Packing
Co., 429 N 13th St.,
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Brittain, J. B.,
Asst. to Comp.,
Pennsylvania Lines,
Union Station,
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Brown, A. D.,
C. C. to Genl. Manager,
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care H. W. Johns-
Manville Co.,
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Brown, John T.,
Vice Pres. and Genl. Manager,
Damascus Bronze Co.,
Allegheny, Pa.

Brown, John T., Jr.,
Supt. Duquesne Reduction Co.,
Farmers Bank Building,
Pittsburgh, Pa.

Brown, Raymond B.,
Manager,
Duquesne Reduction Co.,
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R. R. Supply Agent,
Oil Well Supply Co.,
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Buchanan, E. G.,
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Buckley, J. T.,
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Buffington, W. P.,
C. C. to Supt. Trans.,
Pittsburgh Coal Co.,
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Burgher, R.,
Pres't., Kidd Bros. & Burgher
Steel Wire Co.,
Aliquippa, Pa.

Burkhard, A. A.,
Ass't. General Foreman,
N. Y. C. & H. R. R. Co.,
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Burns, Robert C.,
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P. R. R. Co.,
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Campbell, I. K.,
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Pittsburgh, Pa.

Campbell, W. A.,
Sec. and Treas.,
Vulcan Crucible Steel Co.,
Aliquippa, Pa.

Campbell, W. S.,
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Cardwell, J. R.,
Pres., Cardwell Mfg. Co.,
Monadnock Block,
Chicago, Ill.

Carney, J. J.,
Foreman Erecting Shop,
B. & O. R. R.,
Glenwood Shops,
Pittsburgh, Pa.

Carson, G. E.,
Div. Master Car Builder,
N. Y. C. & H. R. R. R. Co.,
W. Albany, N. Y.

Cassidy, D. E.,
M. M., West Penn Div.,
P. R. R. Company,
Allegheny, Pa.

Chamberlain, E.,
Chairman F. C. R. Pool,
N. Y. C. Lines,
Grand Central Station,
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Chapin, E. S.,
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Charles, J. G.,
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Monon. Con. R. R.,
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Chislett, Wm. B.,
Pass. Condr., P. R. R. Co.,
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Chittenden, A. D.,
C. C. to Genl. Manager,
B. & L. E. R. R.,
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Christiansen, A.,
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Clark, Chas. H.,
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Franklin, Pa.

Coffin, W. E.,
Rep. National Malleable
Castings Co.,
Care "The Stratford,"
Cleveland, O.

Colburn, Wm. W.,
C. E., Pressed Steel Car Co.,
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Cole, Jewett,
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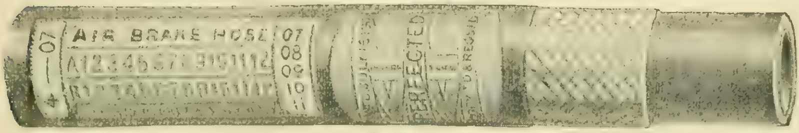

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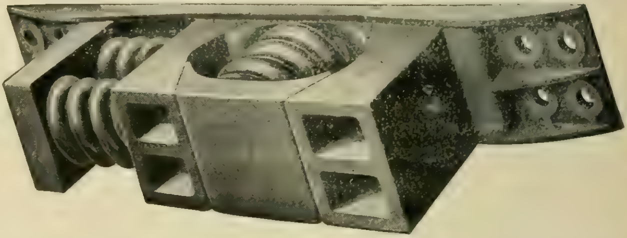

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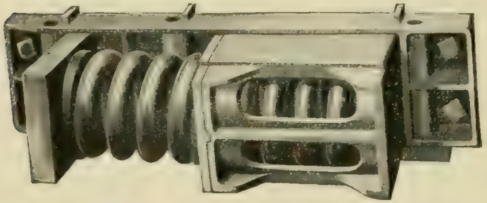

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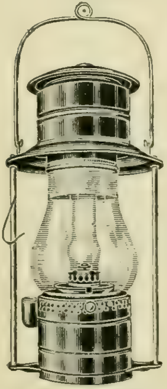

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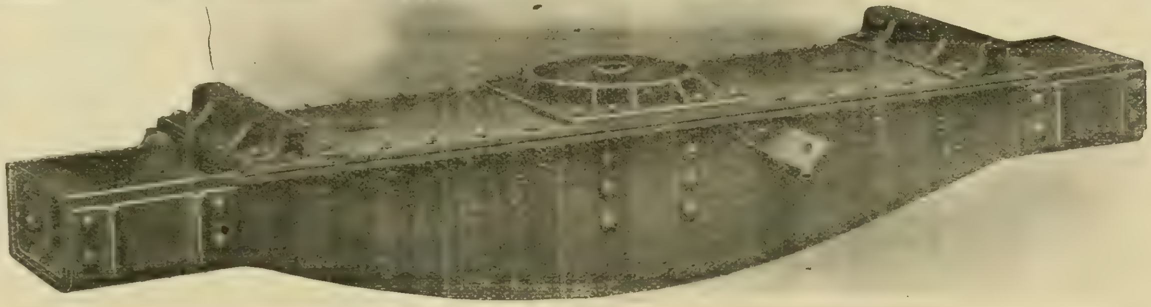

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